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NUCLEAR WEAPON ENVIRONMENT MODEL, FINAL REPORT

Volume II—Computer Code User's Guide

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The Nuclear Weapon Environments Model (NWEM) computer code has been developed to calculate launch and aimpoint exclusion contours. This report documents the computer code, its structure, the function and purpose of each subroutine, the definitions of the common block variables, the input and output, the sample problems, and the maintenance and update of the code.

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1.0 INTRODUCTION

The Nuclear Weapons Environments Model (NWEM) code development project was a six month effort to create a nuclear preprocessor for the Air Force Advanced Missile Computer Model (AMM) being developed by Logicon Company.

The development of NWEM was viewed as an evolutionary process where a relatively complete, although simplified, set of launch and aimpoint exclusion contour methodologies will be developed. As these are utilized in NWEM and the dominant environments for the scenarios of interest become apparent, the most important can be improved in accuracy and new effects or damage mechanisms introduced. The NWEM code has been brought to a state of development where this can be accomplished.

1.1 OVERVIEW OF USERS' GUIDE

The NWEM Computer Code User's Guide, Volume II of the three volume documentation of the NWEM project, contains the description of the code for the user. In Section 2 of this volume the code is described. The code structure is developed and explained. The purpose and function of each subroutine is discussed together with a list of input and output variables, common blocks and calls. The major code areas and subroutines are functionally flowcharted. The variables contained in each common block are defined. An input guide and sample problem description are presented. Section 3 contains sufficient information to allow the user to maintain and update the code.

2.0 CODE DESCRIPTION

The objective of the NWEM code is to generate land based booster and land targeted ballistic RV exclusion contours which result from a single nuclear detonation of an incoming RV and corresponding vulnerability/hardness criteria for the booster or RV. For boosters, NWEM generates exclusion contours for blast, dust, pebble/ejecta, thermal radiation, neutron, x-ray and high altitude EMP. For reentry vehicles, NWEM generates exclusion contours for blast, dust, pebble/ejecta, neutrons and gammas. The philosophy chosen to perform the computation of the exclusion regions was one of simple but reasonably accurate models of the environment combined with vulnerability criteria to determine detailed exclusion contours. These detailed contours are simplified and combined to give exclusion contours which satisfy AMM code requirements. The advantage of explicitly performing environment calculations for generation of the exclusion contours is flexibility. Changes in the vulnerability criteria, trajectories or vehicle parameters are directly reflected in the contours; therefore, a direct calculation allows a wide range of system parameter variation. Additionally, the existing models of the environments can be replaced with more sophisticated models if necessary and new contours easily generated.

The NWEM code, at its present state of development, is a valuable tool for the analysis of reentry vehicle fratricide and booster launch exclusion regions. The code is quick running, uses low computer core requirements and is operating on both IBM and CDC hardware. Two modes of operation are available. A detailed output option can be used by the nuclear effects analyst to evaluate relative importance of the environments, effects of uncertainties and sensitivity to vulnerability level. The normal output mode is designed for compatibility with the AMM targeting and systems evaluation code.

The completed, first version of the NWEM code, is designed to test environment generation models, system utilization options and system vulnerability levels as they affect fratricide and launch exclusion. It was not designed to reproduce the best calculations of environment using state-of-the-art codes, as this was not consistent with the computer run time and core storage requirements or with the program schedule. NWEM

should be viewed as a parametric analysis tool. In this role it can be extremely valuable in developing increased understanding of the relative importance of competing environments and effects and to prioritize areas for research in environment generation and systems vulnerability.

Because extensive efforts were made to program in American Standard FORTRAN and use structured top-down programming practices, the NWEM code has had only minor difficulties being made operational on the AF/PAC IBM 3032 and TRW's 370/158 as well as the TRW CDC Cyber 174/7418 system on which it was developed. Additionally, to make the transition from one computer system to another, care has been taken to keep the input and output to a minimum. The only input/output files used by the code are standard input (5) and output (6) with an additional output file (16) for the AMM exclusion contour data.

The various core size and time requirements are as follows:

	Core	Run Time
TRW CDC Cyber 174/7418	100,000 Octal Words	60-120 Seconds
TRW IBM 360/158	200,000 Decimal Bytes	120-180 Seconds
AF PAC IBM 3032	200,000 Decimal Bytes	30-60 Seconds

2.1 PROGRAM STRUCTURE

The NWEM computer code calculates booster and RV exclusion region contours for use with the AMM program. NWEM is a stand-alone preprocessor of relatively small core size and short running time. It is programmed in American Standard FORTRAN and uses structured top-down programming. The driving parameters or input to NWEM are the vehicle kill criteria, trajectory (boosters) or vehicle dimension parameters (RVs), and the nuclear weapon characteristics and transmission data for the detonating RV. The results of an NWEM run are the AMM exclusion region descriptions on the AMM output file (16) and detailed contour data to various degrees (selectable by the user) on the standard output file (6).

Since certain environments are modeled or used by both boosters and RVs, a philosophy was chosen that each environment and its related exclusion contour would be calculated sequentially and a flag used to define whether the calculation is for a booster or an RV. The advantage

of treating the environments and the associated contours in this manner is that it allowed for rapid development/assembly of environment models and contour generation routines since some of the routines were able to be assembled, derived or modified from existing programs.

In one sense, NWEM is really a collection of environment exclusion region generators assembled together by a common input and by algorithms which manipulate their outputs into final contours in the required AMM format and within the AMM restrictions. Indeed, this philosophy is even carried out to the extent that the radiation environments are separated in a similar form from the mechanical environments.

Briefly, the functional flow of NWEM can be described as: (1) initialize data storage, (2) input and prepare data storage, (3) combine exclusion contours to meet AMM requirements for radiation and mechanical environments, (4) construct final contours, and (5) output final AMM exclusion region data. For an MRV problem, an additional calculational step and combination of multiple burst contours occurs.

2.2 SUBROUTINE DESCRIPTION

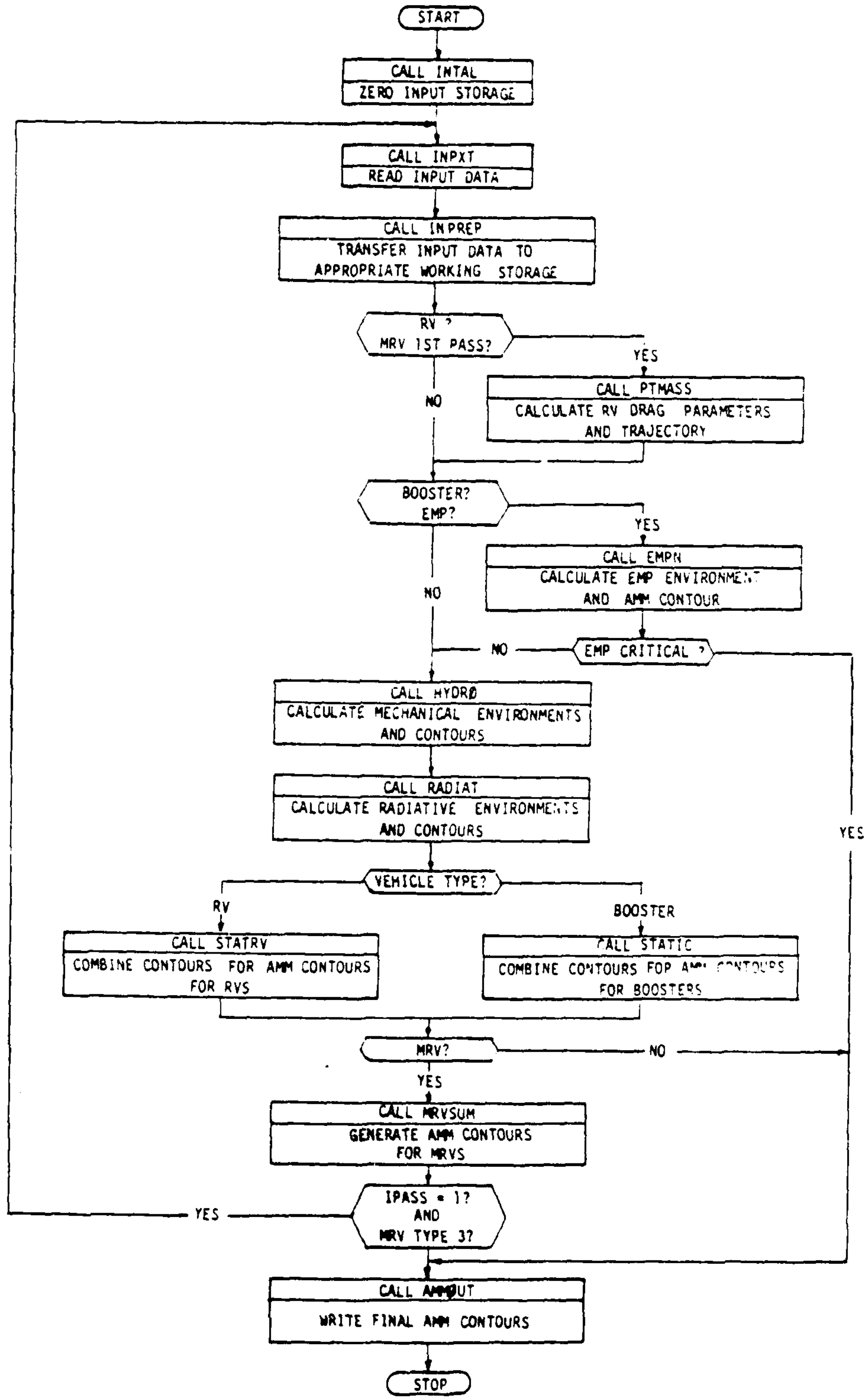
This version of the NWEM computer code has 104 subroutines or functions. These routines vary from very complex to simple. To provide the user with a basis of understanding the function of the subroutines, a format for presentation has been selected which allows the routines to be decoupled from the calling routines and treated individually. For each subroutine, a description of what it does, the argument list variables and their definitions, the variables of concern from each common block (defined in the common block description), data statement variables and their definitions and the names of routines called are given if appropriate. Additionally for those routines which control the calculational flow of the program, functional flow diagram are included. These subroutine descriptions are presented on the following pages in alphabetical order except for the main routine which is first.

NWEM Nuclear Weapons Environments Model

This is the executive routine for the Nuclear Weapons Environments Model computer code It directs the order of input, calculation and output.

Tape file 5	This is the input file
Tape file 6	This is the program output file
Tape file 16	This is the AMM exclusion region data output file
Common blocks used	/HTRNS/, /ITRNS/, /TRNSL/, /TRNS/, /XTITL/
IPASS	Flag indicating number of passes through the calls for MRV's of the third type
Routines called:	INTAL, INPXT, INPREP, PTMASS, ERRØUT, ØUTIN EMPN, HYDRØ, RADIAT, STATIC, STATRV, MRVSUM, AMMØUT, ABØUT

NWEM PROGRAM FLOW DIAGRAM



SUBRØUTINE ABØUT (NF)

This routine stops program execution either for a normal termination or a termination resulting from code error messages.

NF	input	Flat to indicate type of termination (0/1 - normal/error)

Routines called: ERRØUT

SUBRØUTINE AIR (EEE, RRR, GM)

This routine is a real air equation of state model based on work at Air Force Weapons Laboratory.

EEE	input	Specific internal energy (ergs/g)
RRR	input	Density (g/cm^3)
GM	output	γ-1 where γ is the ratio of specific heats.

FUNCTIØN AIRMAS(T)

This routine defines the total mass loading (kT) of the dust cloud.

T	input	Time after burst (sec)
CØMMØN /THREAT/	input	I
CØMMØN /MASSY/	input	A1, A2, A5, A6, B1, B2, B5, B6, T0, T1, T3, T4, T5, T6, WD3, WD4, WD5

SUBRØUTINE ALTSET (H1, ALT, NSAVE)

This routine sets up the altitude break points used for the calculated RV trajectory.

H1	input	Initial incoming altitude of the RV (ft) (Maximum used is 300000. ft)
ALT	output	Altitude break point array (ft)
NSAVE	input	Number of break points allowed. NSAVE-1 will be calculated

SUBRØUTINE AMMØUT

This routine writes the AMM exclusion region data output file (16) and if selected the same data formatted to the code output file (6).

CØMMØN /HTRNS/	input	All variables
CØMMØN /ITRNS/	input	ITYPE
CØMMØN /TRNS/	input	RVANG
CØMMØN /RVC/	input	FR, FRA
CØMMØN /BST/	input	FBR, FRC, FRD,
CØMMØN /XTITL/	input	LEVØUT
Routines called:		ERRØUT

SUBRØUTINE BFØØT (T1, ZO, Z1, Z2, YDT, YSTAR, TSTAR, IV, DL, WID, CEN, RMAX, RMIN, PHI1, PHI2, IFØØT)

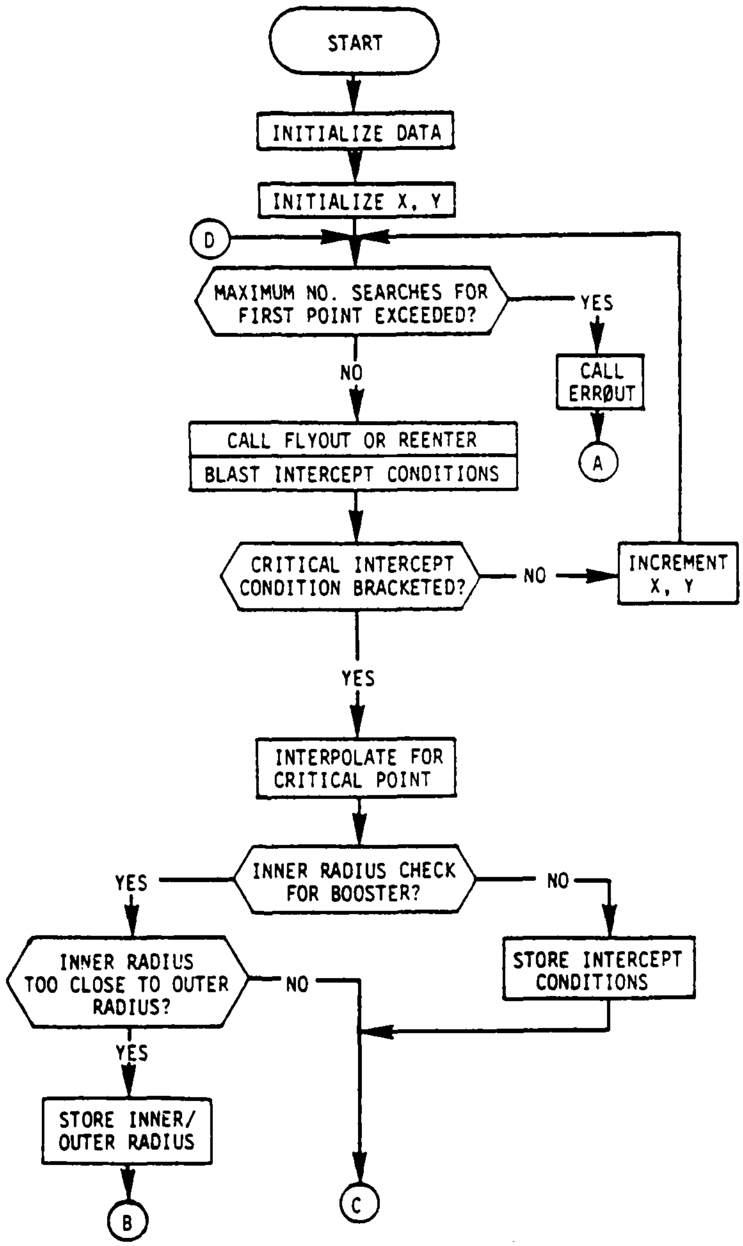
This routine constructs an entire footprint at the given time after burst and then defines the simplified footprint dimensions.

T	input	Time after burst (sec)
ZO	input	Ground plane altitude (kft)
Z1	input	Lead RV burst altitude (kft)
Z2	input	Trailing RV burst height (RV) or missile launch altitude (booster) (kft)
YDT	input	Effective burst yield for blast (Mt)
YSTAR	input	Trajectory offset for burst above sea level (RV only) (kft)
TSTAR	input	Trajectory time offset for burst above sea level (RV only) (kft)
IV	input	Vehicle type. 2 for booster, 4 for RV
DL	output	Rectangular region half-length (kft)
WID	output	Rectangular region half-width (kft)
CEN	output	Uprange/downrange position of rectangle center (kft)
RMAX	output	Annular region, maximum radius (kft)
RMIN	output	Annular region, minimum radius (kft)
PHI1	output	Central angle of uprange (RV) or downrange (booster) annular segment (degrees)
PHI2	output	Central angle of downrange (RV) or uprange (booster) annular segment (degree)
IFØØT	output	Flag. IFØØT = 0 for no footprint
CØMMØN /XTITL/	input	LEVØUT
NMAX	data	Maximum number of iterations allowed in determining the blast footprint (200)
YØLD	data	Internal parameter initialized to zero

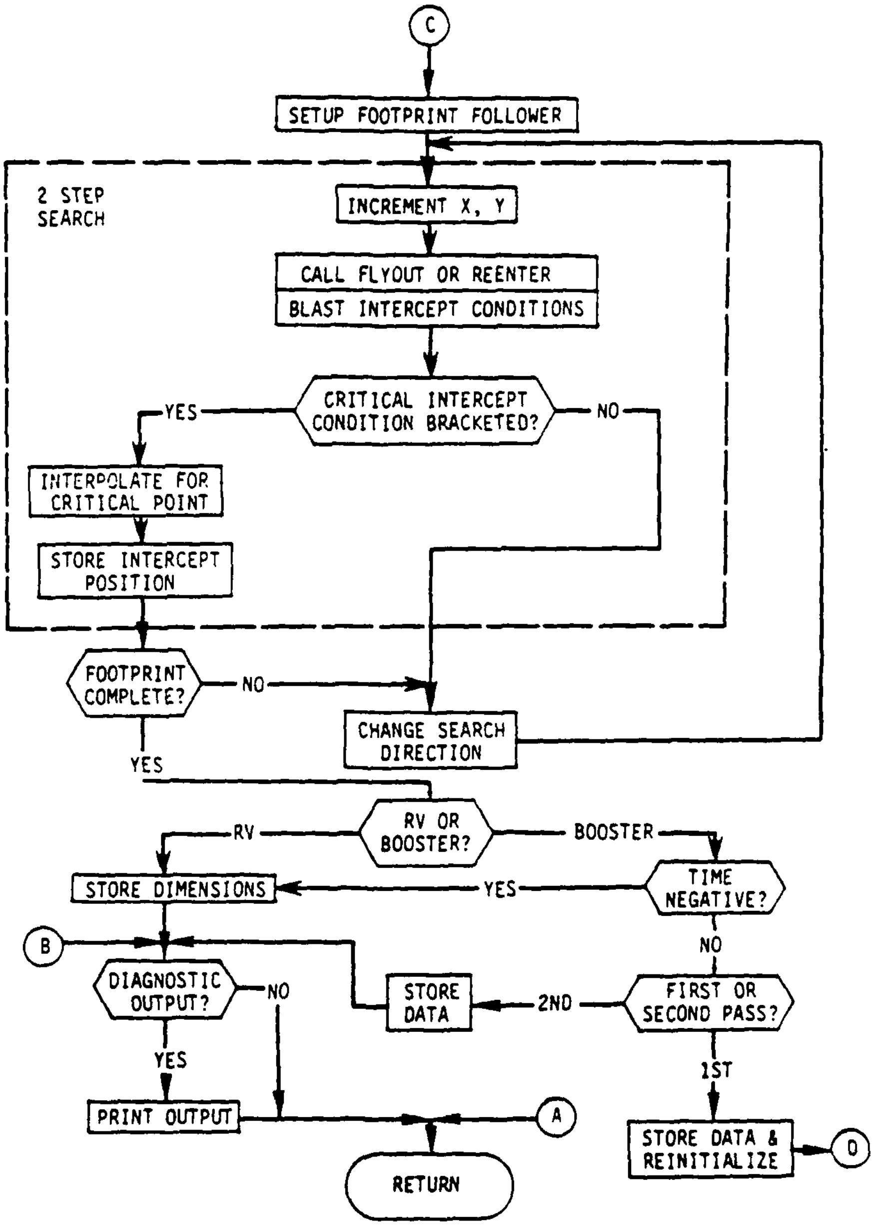
CØLD	data	Internal parameter initialized to zero
RØLD	data	Internal parameter initialized to zero
SIGN2	data	Internal parameter initialized to zero
SS	data	Internal parameter initialized to zero
SSAVS	data	Internal parameter initialized to zero
SSN	data	Internal parameter initialized to zero
SSN2	data	Internal parameter initialized to zero
SSY	data	Internal parameter initialized to zero

Routines called: FLYØUT, REENTR, ERRØUT

SUBRØUTINE BFØØT FLOW DIAGRAM



SUBRØUTINE BFØØT FLOW DIAGRAM (Con't)



SUBRØUTINE BISRCH (TMAX, TMIN, A, TX, TY, XP, YP, ZP, R, RS, XLP, YLP, T, YD, Z1, Z2, IV)

This routine performs a binary search to determine shock front and vehicle intercept time and position.

TMAX	input	Maximum limit of time interval to be searched (sec)
TMIN	input	Minimum limit of time interval to be searched (sec)
A	input	Search flag. A = +1 for missile flying into shock. A = -1 for missile flying out of shock region.
TX	output	Intercept time after burst (sec)
TY	output	Intercept time after missile launch (sec)
XP	output	Intercept position component perpendicular to trajectory plane (kft)
YP	output	Intercept position horizontal component parallel to trajectory plane (kft)
ZP	output	Intercept position. Altitude above ground plane (kft)
R	output	Slant range from burst point to vehicle (kft)
RS	output	Shock radius (kft)
XLP	input	Missile launch point relative to burst. Component perpendicular to trajectory. (kft)
YLP	input	Missile launch point relative to burst. Component parallel to trajectory (kft)
T	input	Launch time after burst (sec)
YD	input	Effective blast yield of burst (Mt)
Z1	input	Burst elevation (kft)
Z2	input	Launch point elevation (kft)
IV	input	Vehicle type. 2 for booster, 4 for RV

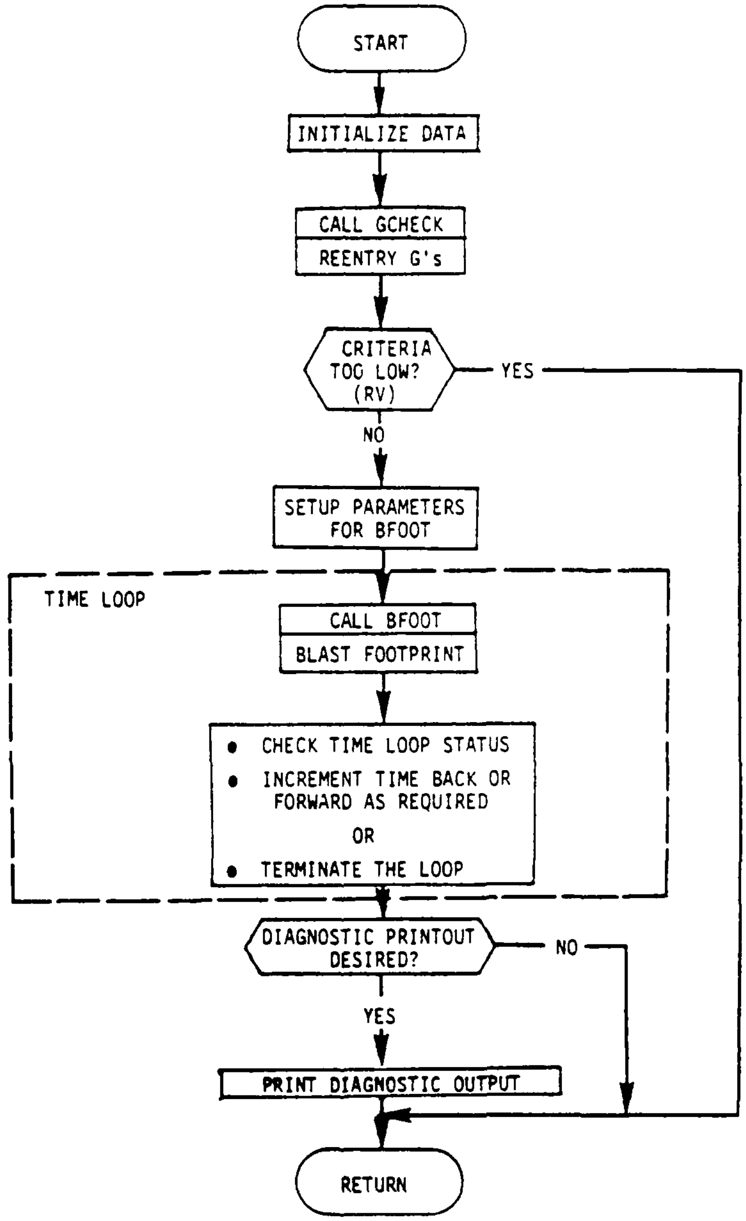
Routines called: VLØC, RSHK

SUBRØUTINE BLAST (YD1, Z0, Z1, Z2, CR1, CR2, CR3, IV)

This routine is a sub-executive which controls the development of the time dependent blast exclusion region.

YD1	input	Burst yield (Mt)
Z0	input	Ground plane elevation (kft)
Z1	input	Lead RV burst altitude (kft)
Z2	input	Trailing RV burst height (RV) or missile launch altitude (booster) (kft)
CR1	input	Blast kill criteria one: Booster - overpressure (psi) RV - total acceleration (g)
CR2	input	Blast kill criteria two: Booster - Overpressure/ambient pressure ratio RV - axial acceleration (g)
CR3	input	Blast kill criteria three: Booster - $q \cdot \alpha$ (psf-deg) RV - normal acceleration (g)
IV	input	Vehicle type: 2 booster, 4 for RV
CØMMØN /BDAT/	output	T. BL, BW, BC, BRMX, BRMN, PH1, PH2, NR, NC
CØMMØN /HTRAJ/	input	TIM, RNG, ZZ, ND
CØMMØN /CONST/	output	THRD, P1, C1, R1, T1
CØMMØN /XTITL/	input	LEVØUT
Routines called:		MATM62, GCHECK, ERRØUT, TERPL, BFØØT

SUBRØUTINE BLAST FLOW DIAGRAM



SUBRØUTINE CDBCMP (CDB)

This routine calculates the base drag coefficient

CDB	output	Coefficient of base drag
CØMMØN /BC/	input	TCDEG, TCRAD, SINTC, CØSTC, RN, RB
CØMMØN /FPSC/	input	XM8
CØMMØN /GPC/	input	GAM8
CØMMØN /TRNSC/	input	LAMINR
CØMMØN /PTMC/	input	PI
TABM8	data	Mach numbers table
TABCO	data	Reference base drag coefficients corresponding to the Mach numbers
IBO	data	Number of Mach numbers in table

Routines called: FNFME, FNFRE, TERPL

SUBRØUTINE CDFCMP (CDP)

This routine calculates the coefficient of pressure drag on the body.

CDP	output	Coefficient of pressure drag
CØMMØN /BC/	input	TCDEG, SINTC, CØSTC, RN, RØ
CØMMØN /FSPC/	input	XM8
CØMMØN /GPC/	input	GAM8
XMTAB	data	Mach numbers
TAB06 TAB09 TAB012 TAB015 TAB26 TAB29 TAB212 TAB215 TAB46 TAB49 TAB412 TAB415	data	Subsonic-transonic forebody pressure drag coefficients for various bluntness ratios and cone half angles (For a give TABXZ the data would be bluntness ratio X, cone half angle Z; i.e., TAB412 is for a bluntness ratio of 4 and cone half angle of 120).
TCTAB	data	Cone half angles
BRTAB	data	Bluntness ratios
I18	data	Number of Mach numbers and associated subsonic-transonic forebody pressure drag coefficients
I4	data	Number of bluntness ratios and associated subsonic-transonic forebody pressure drag coefficients

Routines called: TERPL, QUAD, FNFP

SUBRØUTINE CDFLAM (CDFL)

This routine calculates the coefficient of laminar frictional drag on the body.

CDFL	output	Coefficient of laminar frictional drag
CØMMØN /BC/	input	TCDEG, CØSTC, TANTC, RN, RB
CØMMØN /FSPC/	input	U8, RHØ8, XMU8, XM8, REFT8, Q8
CØMMØN /GPC/	input	PR
CØMMØN /LPNC/	input	All variables
Routines called:		CDFXQ, FNFFL, FNBLL

SUBRØUTINE CDFMIX (CDFTT, CDF)

This routine calculates the skin fraction drag coefficient when flow is mixed laminar and turbulent.

CDFTT	input	Turbulent skin friction drag coefficient
CDF	output	Skin friction drag coefficient
CØMMØN /BC/	input	RN, RB
CØMMØN /TRNSC/	input	RNRTR
Routines called:		CDFTRB, CDFLAM

SUBRØUTINE CDFTRB (CDFT)

This routine computes the coefficient of turbulent frictional drag on the body.

CDRT	output	Coefficient of turbulent frictional drag
CØMMØN /BC/	input	TCDEG, CØSTC, TANTC, RN, RB, XK
CØMMØN /FPSC/	input	U8, RHØ8, XMU8, XM8, REFT8, Q8
CØMMØN /GPC/	input	PR
CØMMØN /LPNC/	input	All variables
Routines called:		CDFXQ, FNFFT, FNRGH, FNBLT

SUBRØUTINE CDFXQ (XM8, TW)

This routine calculates the RV body temperature for the given Mach number.

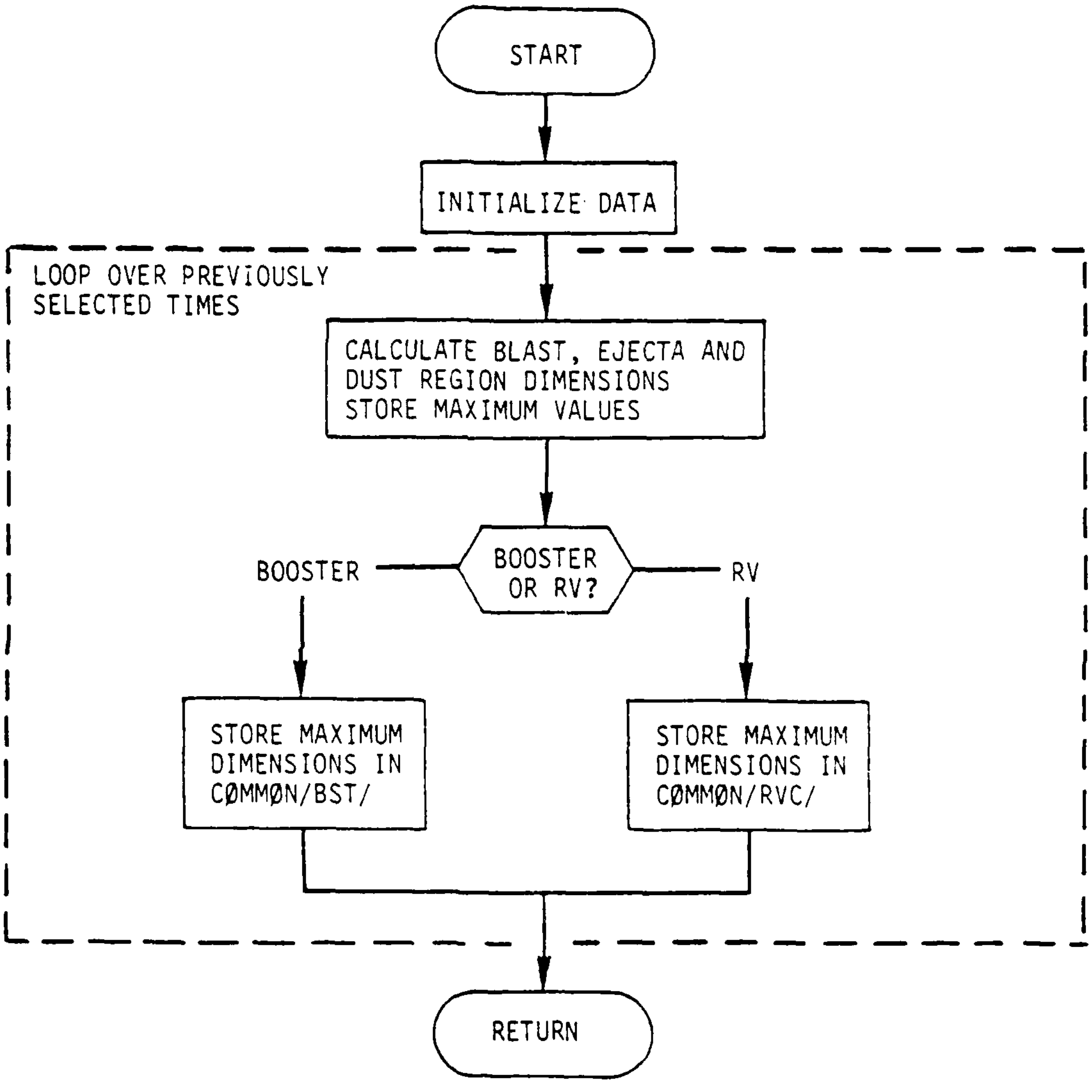
XM8	input	Mach number
TW	output	RV wall temperature
XMTAB	data	Mach numbers
TWTAB	data	Body wall temperatures corresponding to the Mach numbers (°R)
I6	data	Number of Mach number values in table
Routines called:		TERPL

SUBRØUTINE CØMP (T1, T2, N, M, IV)

This routine produces composite footprints during a given time interval based on maximum dimensions of blast, ejecta and dust footprint data.

T1	input	Beginning of time interval (sec)
T2	input	Ending of time interval (sec)
N	input	Number of times at which composite footprints are required
M	input	Index which defines the beginning location for storage of composite footprint data in common blocks BST and RVC
IV	input	Vehicle type; 2 for booster, 4 for RV
CØMMØN /BDAT/	input	TB, BL, BW, BC, NR
CØMMØN /DDAT/	input	TD, DL, DW, DC, ND
CØMMØN /EDAT/	input	TE, EL, EW, EC, NE
CØMMØN /BST/	output	FØTLWC, NFØ
CØMMØN /RVC/	output	TMFLWC, NTM
Routines called:		TERPL, CØNVRT

SUBRØUTINE CØMP FLOW DIAGRAM



SUBRØUTINE CØMPAR (IPHASE, ITMAX, J)

Calculates maximum radiation contour extent over all times for each radiation environment.

IPHASE	input	See /RAD/
ITMAX	input	Maximum number of times, T(I), for which lethal volume size is calculated for the current radiation environment 4 - Surface burst 5 - Lethal volume intersects surface. Grazing trajectory is below the earth's surface so PT17 places the last point at the surface 6 - Lethal volume intersects surface. SUBRØUTINE PTMAX calculates the next to last data point (five 5) 7 - Final time corresponds to a lethal volume point directly below the burst point
J	input	Index of environment type 1 - Neutron fluence 2 - Prompt gamma peak dose rate 3 - X-ray Fluence 4 - Thermal radiation fluence
CØMMØN /RRR/	input	TIMAX, TIMIN, JINDEX, IHMAX, MAXITM, tLØØPS
CØMMØN /RRR/	input	All variables
CØMMØN /RR1/	input	RH
CØMMØN /RR1/	output	RUP, RDN
CØMMØN /XTITL/	input	LEVØUT
Routines called:		None

SUBRØUTINE CØNVRT (HL, CEN, DU, DD, NP)

This routine converts rectangle half-length and position of center to uprange and down range extend.

HL	input	Half-lengths of dynamic rectangular footprint
CEN	input	Positions of rectangle center downrange of burst ground zero
DU	output	Uprange extents of dynamic rectangular foot-print
DD	output	Downrange extents of dynamic rectangular footprint
NP	input	Number of points in dynamic rectangle arrays (Maximum of 50)

SUBRØUTINE CRØSS (XA, XB, NA, NB, TA, TB, XCRS, TCRS)

This routine finds the intersection point of two lines which are defined by linear interpolation of data points.

XA	input	Ordinate data for first line
XB	input	Ordinate data for second line
NA	input	Number of data points for first line (50 Maximum)
NB	input	Number of data points for second line (50 Maximum)
TA	input	Abscissa data for first line
TB	input	Abscissa data for second line
XCRS	output	Ordinate of intersection point
TCRS	output	Abscissa of intersection point

Routines called: TERPL

SUBRØUTINE DRAGX (JTJF, CDTØT)

This routine is a sub-executive routine which directs the computation of the drag coefficients used in calculating the RV trajectory.

JTJF	input	Trajectory flag indicating that this is a coupled trajectory drag coefficient calculation
CDTØT	output	Total drag coefficient
CØMMØN /DRIDR/	input	ISTPAS
CØMMØN /DRIDR/	output	ITJF, ISTPAS
CØMMØN /FSPC/	input	HT, XM8
CØMMØN /GPC/	input	GAM8
CØMMØN /TRNSC/	input	LAMINR
CØMMØN /TRNSC/	output	LAMINR
Routines called:		SP, LP, REDBDY, TRPTID, TØNSET, TRPTTJ, CDFLAM, CDFTRB, CDFMIX, CDBCMP, CDPCMP

SUBRØUTINE DRG (AM, ALPHA, WA, CA, CN)

This routine interpolates on RV drag coefficient data

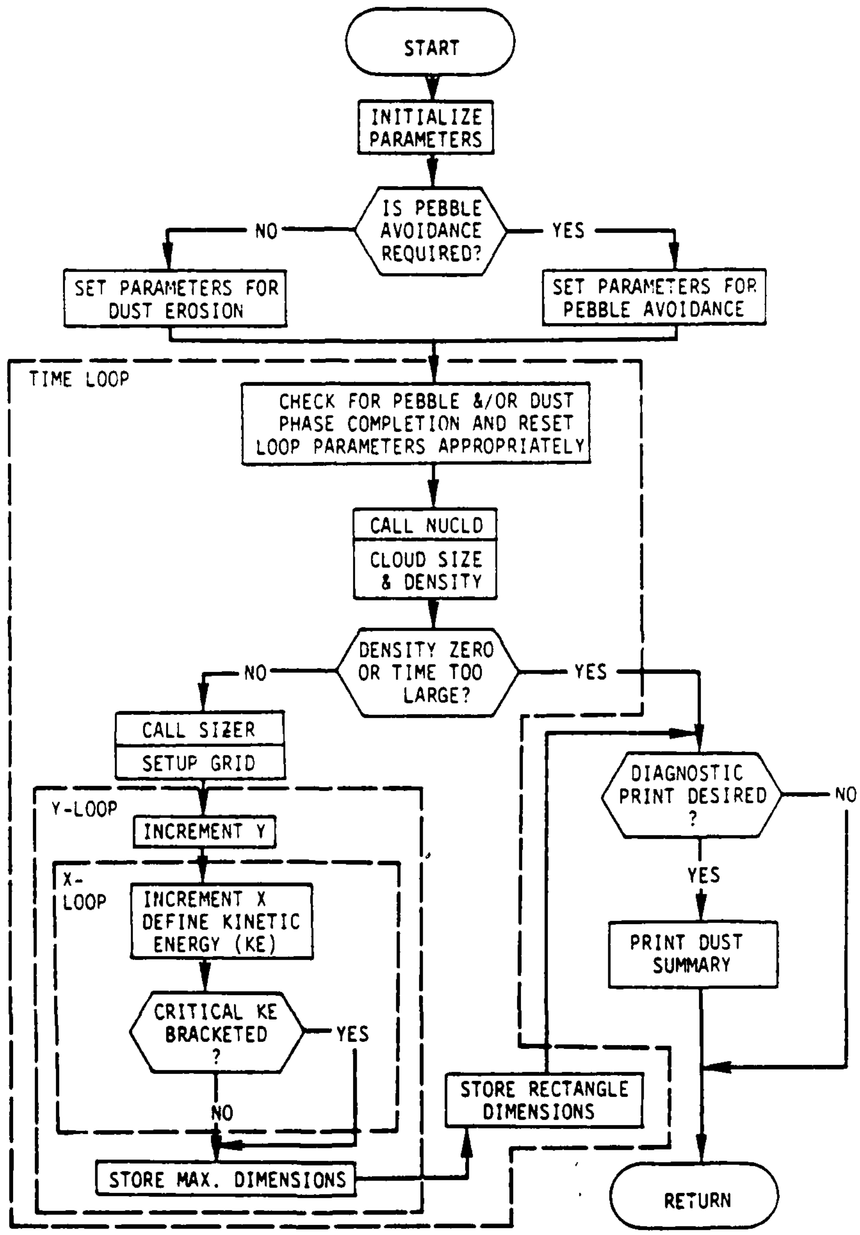
AM	input	RV Mach number
ALPHA	input	RV angle of attack (degrees)
WA	output	RV weight to area ratio (lbs/ft^2)
CA	output	Axial drag coefficient
CN	output	Normal drag coefficient
CØMMØN /DRAG/	input	CNBP, CXBP, ALFBP, AMBP, WN, NA, NM
Routines called:	TERPL2	

SUBRØUTINE DUST (WB, HØB1, HØB2, ECRITX, TQUITX, TQUIT)

This routine is a sub-executive which defines cloud avoidance and dust erosion exclusion regions.

WB	input	Burst yield (Mt)
HØB1	input	First RV burst elevation (ft)
HØB2	input	Second RV burst elevation (ft) or booster launch elevation (ft)
ECRITX	input	Critical level of intercepted kinetic energy ($ft\text{-}lb/ft^2$)
TQUITX	input	Dust cloud cutoff time (sec)
TQUIT	input	Pebble avoidance cutoff time (sec)
CØMMØN /BURST/	output	HT, HM, RM, RB, RHØ, HBRV
CØMMØN /DIMEN/	input	NY, NX, YMAX, DY, DX
CØMMØN /HTRAJ/	input	RR, AA, NN
CØMMØN /DDAT/	output	T, HL, HW, YC, NF
CØMMØN /XTITL/	input	LEVØUT
Routines called:		NUCLD, SIZER, TERPL, SLØPE, ENERGY, ERRØUT

SUBRØUTINE DUST FLOW DIAGRAM



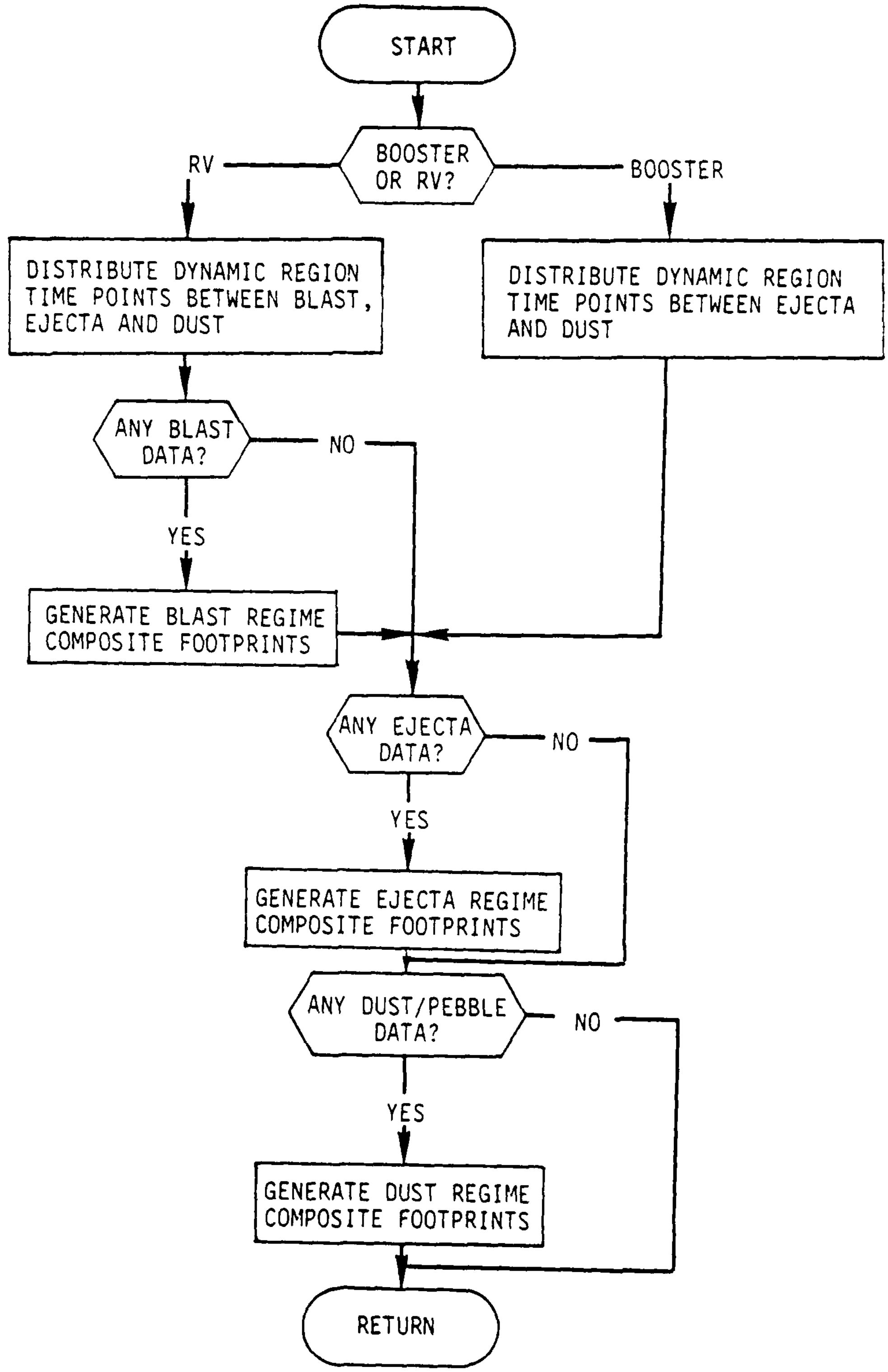
SUBRØUTINE DYCØMB (IV)

This routine manages the combination of blast, ejecta and dust footprint data into one dynamic footprint.

IV	input	Vehicle type; 2 for booster, 4 for RV
CØMMØN /BDAT/	input	TB, BL, BW, BC, NR
CØMMØN /DDAT/	input	TD, DL, DC, ND
CØMMØN /EDAT/	input	TE, EL, EC, NE

Routines called: CØMP, XLIM, CØNVRT, CRØSS

SUBRØUTINE DYCØMB FLOW DIAGRAM

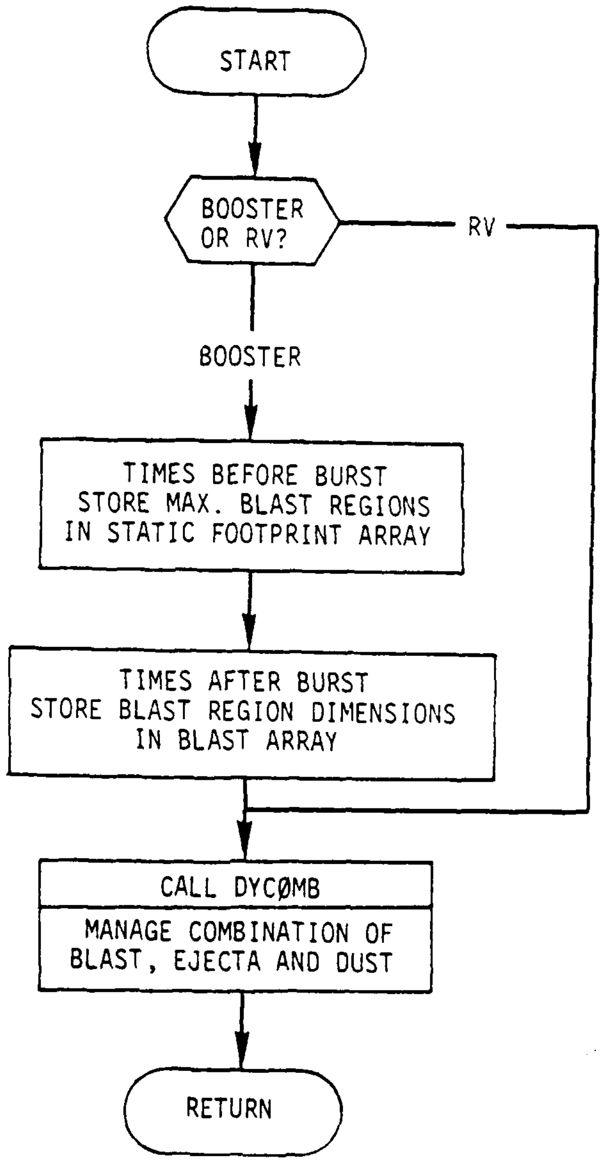


SUBRØUTINE DYNAM (IV)

This routine controls the filling of static and dynamic footprint arrays for blast, ejecta and dust footprints.

IV	input	Vehicle type; 2 for booster, 4 for RV
CØMMØN /BDAT/	input	TB, BL, BW, BC, BRMX, BRMN, PH1, PH2, NR, NC
CØMMØN /STA/	output	TMN, TMX, RHMX, RUPMN, RDNMX, IDATA
CØMMØN /BST/	output	BLANG, NBL
Routines called:		XLIM, CØNVRT, DYCØMB

SUBRØUTINE DYNAM FLOW DIAGRAM



SUBRØUTINE EARLY (T, HT, HM, RM, RB)

This routine defines the early time dust cloud dimensions for times after burst of one minute or less.

T	input	Time after burst (sec)
HT	output	Dust cloud top height (kft)
HM	output	Dust cloud middle height (kft)
RM	output	Dust cloud middle radius (kft)
RB	output	Dust cloud base radius (kft)
CØMMØN /THREAT/	input	I, SHØLD, HØB
CØMMØN /STUFF/	input	AFB, AHM, AHT, ARM, BFB, BHM, BHT, BRM, RFS, TBØ, TFS, TFW, TLØ
	output	RFB
THIRD	data	One third
Routines called:		RBASE

SUBRØUTINE EJCLD (T, W, SHØB, HT, RM, RHØ)

This routine defines the ejecta cloud dimensions and density.

T	input	Time afterburst (sec)
W	input	Burst yield (Mt)
SHØB	input	Scaled height of burst (ft/kt$^{1/3}$)
HT	output	Ejecta cloud top height (kft)
RM	output	Ejecta cloud maximum radius (kft)
RHØ	output	Ejecta cloud density
CØMMØN /ECØNS/	input	BBB, HIN, HPK, RIN, RPK, THP, THT, TRP, TRT
Routines called:		EJCØNS

SUBRØUTINE EJCØNS (W)

This routine defines yield dependent constants for EJCLD.

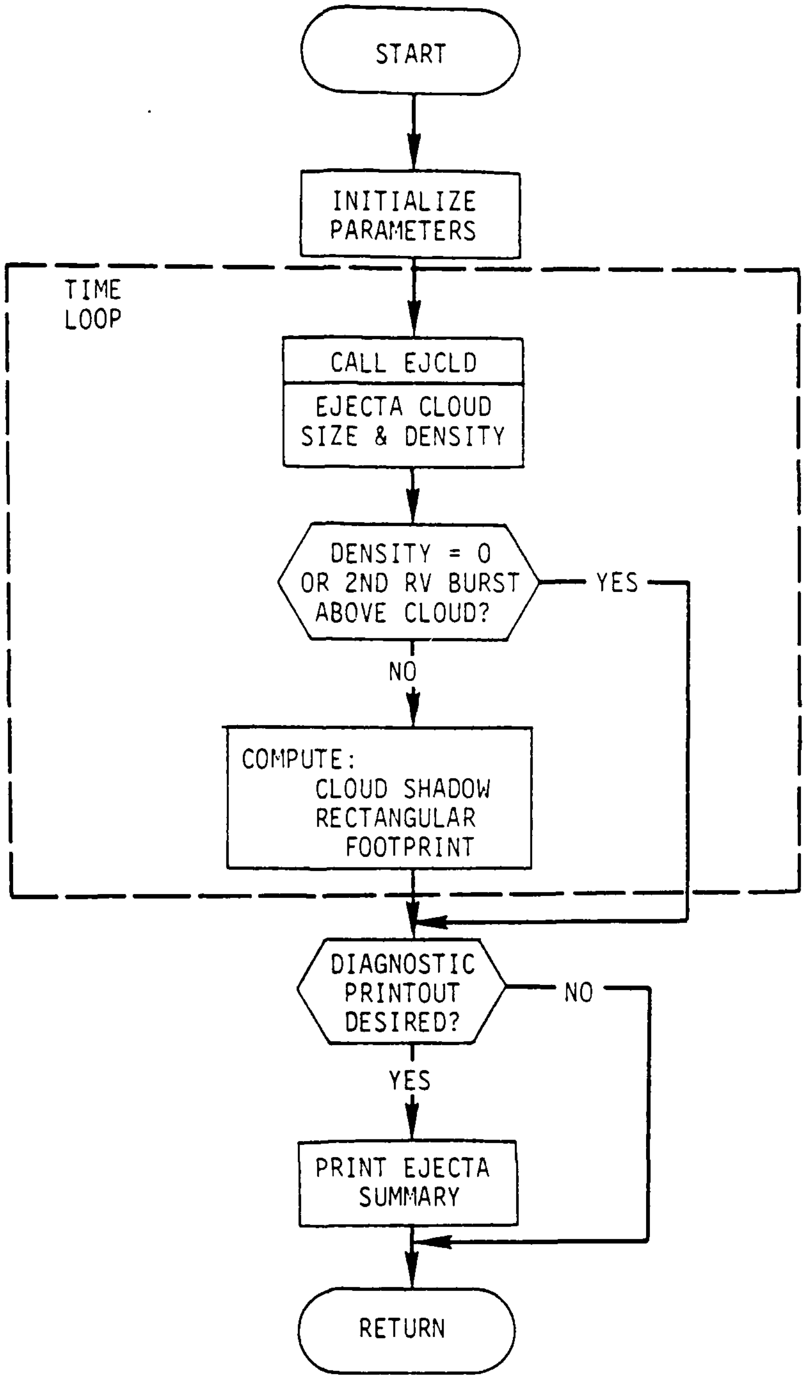
W	input	Burst yield (Mt)
CØMMØN /ECØNS/	output	BBB, HIN, HPK, RIN, RPK, THP, THT, TRP, TRT

SUBRØUTINE EJECTA (WB, HØB1, HØB2, CRITD, CRITN)

This is a sub-executive routine which controls definition of the ejecta cloud exclusion region.

WB	input	Burst yield (Mt)
HØB1	input	First RV burst elevation (ft)
HØB2	input	Second RV burst elevation or booster launch elevation (ft)
CRITD	input	Critical ejecta particle size (dummy)
CRITN	input	Critical number of hits (dummy)
CØMMØN /HTRAJ/	input	AA, RR, NN
CØMMØN /EDAT/	output	T, HL, HW, YC, NF
CØMMØN /XTITL/	input	LEVØUT
Routines called:		EJCLD, TERPL, ERRØUT

SUBRØUTINE EJECTA FLOW DIAGRAM



SUBRØUTINE EMPN (HØB, Y EMP1, ICTØR)

This routine calculates the booster exclusion contour for the high altitude EMP environment.

HØB	input	Burst height (ft)
Y	input	Burst yield (kt)
EMP1	input	EMP Criteria - peak electric field strength (V/m)
ICTØR	output	Flag to specify existence of exclusion contour (0/1 - no contour/contour)
CØMMØN /XTITL/	input	LEVØUT
CØMMØN /TRAJ/	input	T, A, N
CØMMØN /BST/	output	FØRADI, FØTIMS
RE	data	Radius of the earth (km)
ALTL	data	Minimum burst altitude for EMP environment model (km)
ALTC	data	Maximum altitude of the EMP environment (km)
ALT(5)	data	Height of burst data for EMP environment (km)
YG1(9)	data	Gamma ray yield data for EMP environment (kt)
EF(9,5)	data	Electric field strength for EMP environment model (V/m)
Routines called:		ERROUT, TERPL, TERPL2

FUNCTIØN ENERGY (X, Z, EM)

This routine defines intercepted kinetic energy along a given path through a given dust cloud.

X	input	Initial Vehicle cross range coordinate (kft)
Z	input	Initial Vehicle altitude (kft)
EM	input	Trajectory slope $\left(\frac{dz}{dR}\right)$ at Z
CØMMØN /BURST/	input	HT, HM, RM, RB, RHØ, HBRV
CØMMØN /HTRAJ/	input	ALT, VEL, NN
C3	data	Kinetic energy unit conversion constant
EPS	data	Round off epsilon (1.0×10^{9})

Routines called: TERPL

SUBRØUTINE ERRØUT (FMT, X, N, NF, NT)

This routine outputs the data to either the AMM output file (16) and the normal output file (6).

FMT	input	Array containing format information for outputing data
X	input	Array containing the data to be output
N	input	Number of data values to be output. If zero only the format is output
NF	input	Flag to indicate whether this output should be followed by termination of program
NT	input	File (6 or 16) to which data will be output

Routines called: ABØUT

FUNCTIØN FENV (RX, RANGE, J)

Returns the nuclear radiation environment value for a point in space corresponding to a given areal density and range from burst using mass integral scaling.

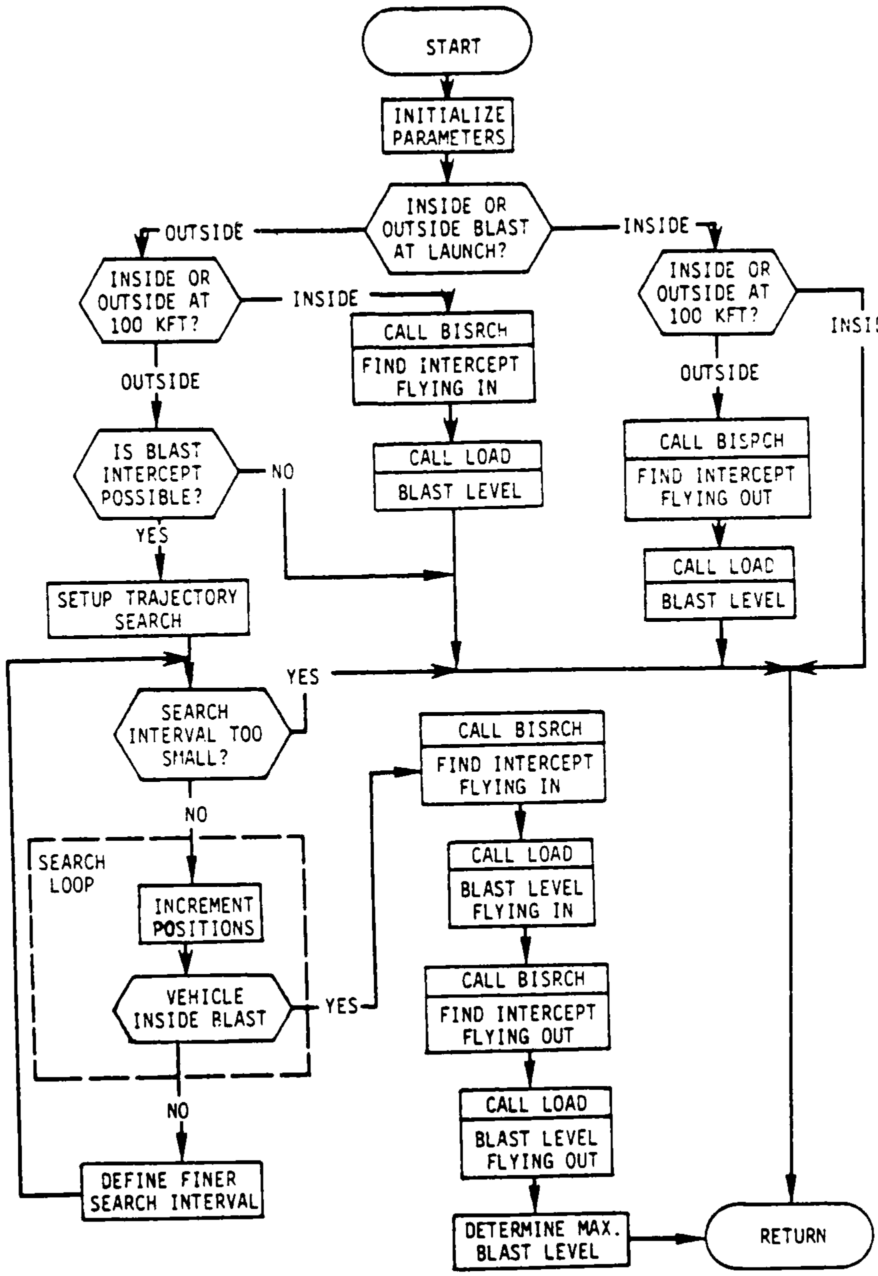
RX	input	Air mass integral (gm/cm^2)
RANGE	input	Range from burst (km)
J	input	Index of environment type whose environment is defined in the units indicated 1 - Neutron fluence (neutrons/cm^2) 2 - Prompt gamma peak dose rate (rad(Si)/sec) 3 - X-ray fluence (cal/cm^2) 4 - Thermal radiation fluence (cal/cm^2)
CØMMØN /ØUT	input	All variables
BFN		Natural logarithm of the build up factor for to exoatmospheric fluence. This has been found by semi-log interpolation of ln (build up data) as a function of air mass integral using TERPL
BFG		ibid. for peak prompt gamma dose rate
BFX		ibid. for X-ray fluence
Routines called:		TERPL

SUBRØUTINE FLYØUT (T, XLP, YLP, Z2 , ZO , Z1 , YD, S, IV, IM)

This routine controls search for booster intercepts with shock waves and defines the resulting environment severity.

T	input	Time of launch after burst (sec)
XLP	input	Launch point distance from burst, coordinate perpendicular to missile trajectory (kft)
YLP	input	Launch point distance from burst, coordinate parallel to missile trajectory (kft)
Z2	input	Missile launch elevation (kft)
ZO	input	Ground plane elevation (kft)
Z1	input	Burst elevation (kft)
YD	input	Effective blast yield (Mt)
S	output	Environment severity. Maximum ratio of environment level to kill criteria
IV	input	Vehicle type: 2 for booster, 4 for RV
IM	output	Critical environment number associated with S
CØMMØN /HTRAJ/	input	TIM, RNG, ALT, NTRAJ
Routines called:		TERPL, RSHK, BISRCH, LØAD, VLØC

SUBRØUTINE FLYØUT FLOW DIAGRAM



SUBRØUTINE FNBLL (BRATIØ, XMACA8, THETAC, BLL)

This routine calculates the skin friction drag blowing correlation function for laminar flow.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
BLL	output	Skin friction drag blowing correlation in function for laminar flow
C	data	Laminar skin friction drag blowing correlation constants for slender RVs
D	data	Laminar skin friction drag blunt RVs

Routines called: SOLV

SUBRØUTINE FNBLT (BRATIØ, XMACH8, THETAC, BLT)

This routine calculates the skin friction drag blowing correlation function for turbulent flow.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV Cone half angle (deg)
BLT	output	Skin friction drag blowing correlation function for turbulent flow
C	data	Turbulent skin friction drag blowing correlation constants for slender RVs
D	data	Turbulent skin friction drag blowing correlation constants for blunt RVs

Routines called: SØLV

SUBRØUTINE FNFFL (BRATIØ, XMACH8, THETAC, FFL)

This routine calculates the smooth, no blowing skin friction drag correlation friction for laminar flow.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
FFL	output	Smooth, no blowing skin friction drag correlation function for laminar flow
C	data	Laminar smooth, no blowing skin friction drag correlations constants for slender RVs
D	data	Laminar smooth, no blowing skin friction drag correlation constants for blunt RVs

Routines called: SØLV

SUBRØUTINE FNFFT (BRATIØ, XMACH8, THETAC, FFL)

This routine calculates the smooth, no blowing skin friction drag correlation friction for turbulent flow.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
FFT	output	Smooth, no blowing skin friction drag correlation function for turbulent flow
C	data	Turbulent smooth, no blowing skin friction drag correlation constants for slender RVs
D	data	Turbulent smooth, no blowing skin friction drag correlation constants for blunt RVs

Routines called: SØLV

SUBRØUTINE FNFME (BRATIØ, XMACH8, THETAC, FME)

This routine calculates the local Mach number correlation function.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
FME	output	Local Mach number correlation function
C	data	Local Mach number correlation constants

Routines called: SØLV

SUBRØUTINE FNFP (BRATIØ, XMACH8, THETAC, FP)

This routine calculates the forebody pressure drag correlation function.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
FP	output	Forebody pressure drag correlation function
C	data	Forebody pressure drag correlation constants

Routines called: SØLV

SUBRØUTINE FNFRE (BRATIØ, XMACH8, THETAC, FRE)

This routine calculates the local Reynolds number correlation function.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
FRE	output	Local Reynolds number correlation function
C	data	Local Reynolds number correlation constants

Routines called: SØLV

SUBRØUTINE FNRGH (BRATIØ, XMACH8, THETAC, RGH)

This routine calculates the skin friction drag roughness correlation function.

BRATIØ	input	RV bluntness ratio
XMACH8	input	Mach number
THETAC	input	RV cone half angle (deg)
RGH	output	Skin friction drag roughness correlation
C	data	Skin friction drag roughness correlation for slender RVs
D	data	Skin friction drag roughness correlation for blunt RVs

Routines called: SØLV

SUBRØUTINE FSP

This routine calculates the free stream properties for RV trajectory drag calculations.

CØMMØN /FSPC/	input	U8, P8, T8, RHØ8, XM8, Q8
CØMMØN /FSPL/	output	H8, HT, XMU8, REFT8, P8PT8
CØMMØN /GPC/	input	CP8, G, GAM8, XJ

SUBRØUTINE FSPX

This routine calculates ambient free stream properties for the RV trajectory from ambient atmosphere properties and RV velocity.

CØMMØN /FSPC/	input	ALT, U8
CØMMØN /FSPC	output	P8, T8, A8, RHØ8, XM8, Q8
Routines called:		MATM62

SUBRØUTINE GCHECK (GMAX)

This routine finds the maximum acceleration along normal reentry trajectory.

GMAX	output	Maximum acceleration along RV trajectory (g's)
CØMMØN /HTRAJ/	input	ALT, VEL, ND
Routines called:		MATM62, DRG

SUBRØUTINE HPREP (WK, H1, H2, DCR1, DCR2, WM, Z0, Z1, Z2, ECRIT, TQUIT)

This routine zeros footprint data arrays and converts input data units.

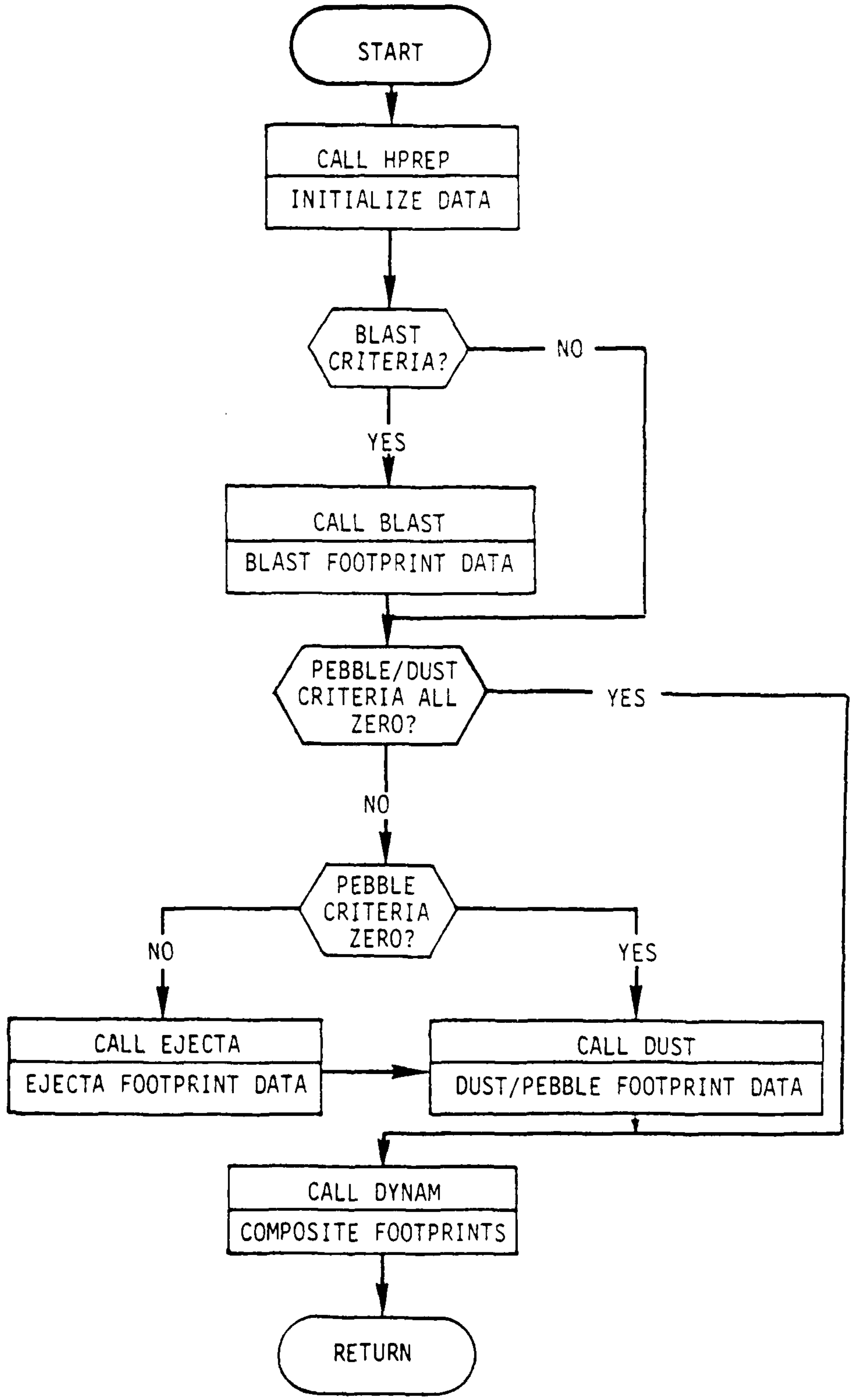
WK	input	Burst yield (kt)
H1	input	Lead RV burst height (ft)
H2	input	Trailing RV burst height or booster launch site elevation (ft)
DCR1	input	Dust erosion criteria one (kJ/cm^2)
DCR2	input	Dust erosion criteria two (min)
WM	output	Same as WK (Mt)
Z0	output	Ground plane elevation (kft)
Z1	output	Same as H1 (kft)
Z2	output	Same as H2 (kft)
ECRIT	output	Same as DCR1 ($ft\text{-}lb/ft^2$)
TQUIT	output	Same as DCR2 (sec)
CØMMØN /TRAJ/	input	T1, R1, A1, V1, AN1, N1
CØMMØN /HTRAJ/	output	T2, R2, A2, V2, AN2, N2
CØMMØN /BDAT/	output	TB, BL, BW, BC, BRMX, BRMN, PH1, PH2, NR, NC
CØMMØN /DDAT/	output	TD, DL, DW, DC, ND
CØMMØN /EDAT/	output	TE, EL, EW, EC, NE
CØMMØN /STA/	output	TMN, TMX, RAMX, RUPMN, RDNMX, IDATA

SUBRØUTINE HYDRØ (WK, H1, H2, BCR1, BCR2, BCR3, DCR1, DCR2, PCR1, PCR2, IPHASE)

This is a sub-executive routine which drives BLAST, EJECTA, DUST, and DYNAM.

WK	input	Burst yield (kt)
H1	input	Lead RV burst height (ft)
H2	input	Trailing RV burst height or booster launch site elevation (ft)
BCR1	input	Blast kill criteria one Booster - ratio of overpressure to ambient pressure RV - total acceleration (g)
BCR2	input	Blast kill criteria two Booster - dynamic pressure times angle of attack (psf-deg) RV - axial acceleration (g)
BCR3	input	Blast kill criteria three Booster - dynamic times angle of attack (psi-deg) RV - normal acceleration (g)
DCR1	input	Dust erosion criteria one, intercepted kinetic energy (kJ/cm^2)
DCR2	input	Dust erosion criteria two, cloud cut-off time (min)
PCR1	input	Pebble/ejecta penetration criteria one, critical particle diameter (cm)
PCR2	input	Pebble/ejecta penetration criteria two, critical hit number density ($\#/cm^2$)
IPHASE	input	Vehicle type; 2 booster, 4 for RV
Routines called:		HPREP, BLAST, EJECTA, DUST, DYNAM

SUBROUTINE HYDRO FLOW DIAGRAM



FUNCTION IBY (UX, X, N)

This function performs a binary search of a data array for the index of lower data point for a given value.

UX	input	Given value for which index is needed
X	input	Data array to be searched
N	input	Number of data in the array

SUBRØUTINE INLINE

Merges blast exclusion region into the dust/ejecta region as a time-dependent set of rectangular exclusion contours. Used for MRV options 2 or 3 during the boost phase only. AMM units are used throughout.

CØMMØN /BST/	input	BLANG, FØTLWC, NBL, NFØ
ILIMBØ		Flag indicating the status of fitting the blast contour times TMINIT(I) into the dynamic contour time array, FØTLWC(1,J): 0 - Previous time has been evaluated select the next blast time for merging blast data into the dynamic array 1 - Continue searching for the dynamic contour time interval in which the blast contour time is located
TMINIT(7)		Blast contour times with units changed to conform with the dynamic times (min)
RBLAST(7)		Blast radius at times corresponding to the dynamic contour times (NMi)
RCTDN(7)		Maximum extent of the final exclusion contour in the downrange direction relative to burst ground zero at each time (NMi)
RCTUP(7)		Minimum extent of the final exclusion contour in the uprange direction relative to burst ground zero at each time (NMi)
WBMAX		Maximum radius of the blast contour within the current dynamic contour time interval (NMi)
TBMAX		Time corresponding to WBMAX (min)
Routines called:		TERPL

SUBRØUTINE INPREP (IPASS)

This routine takes the input data and transfers the data to the appropriate working storage of the program.

IPASS	input	Flag indicating pass number for MRV third type
CØMMØN /ITRNS/	input	ITYPE, NTRJ, NTRJX, NDG1, NDG2, INEUT, INET, IXRAY, IXR
CØMMØN /TRNS/	input	DUST1, DUST2, THERF, XGM1, YLD, XNEUTX, XFRAC, GAMDS, GAMPL, TIMX, ALT, RNG, VEL, ANG, AMX, ANG, ANGX, CN, CA, RHØRN, XNETX, RHØRX, XPHI
CØMMØN /TRNS/	output	DUST3, THER1, XTM1, XTM2
CØMMØN /DRAG/	output	XCN, XCA, XA1, XAM, NA, NM
CØMMØN /ØUT/	output	All variables
CØMMØN /TRAJ/	output	All variables
CØMMØN /WPN/	output	All variables
CØMMØN /SØR/	input	All variables
CØMMØN /TRAJX/	input	All variables
CØMMØN /THER/	input	All variables
CØMMØN /XTITL/	input	LEVØUT
LEVTYP(5)	data	Alphanumeric representation of characters (blank, 0, 1, 2 and 3) for output option
LEVTYX(5)	data	Numeric values associated with LEVTYP (0, 0, 1, 2 and 3)
Routines called:		ERRØUT, TNFR

SUBRØUTINE INPXT (IPASS)

This routine reads the problem input to the program.

IPASS	input	Flag indicating pass number for MRV third type
CØMMØN /HTRNS/	output	All variables
CØMMØN /ITRNS/	output	All variables
CØMMØN /TRNSL/	input	All variables
CØMMØN /TRNS/	output	All variables except DUST3, XTM1 and XTM2
CØMMØN /XTITL/	output	All variables

Routines called: ERRØUT

SUBRØUTINE INTAL

This routine sets the values of the input common block storage and AMM output common block storage to zero (0) to start the problem.

CØMMØN /HTRNS/	output	All variables
CØMMØN /ITRNS/	output	All variables
CØMMØN /TRNSL/	input	All variables
CØMMØN /TRNS/	output	All variables
CØMMØN /RVC/	output	All variables
CØMMØN /BST/	output	All variables

SUBRØUTINE JØUT (TM, RAD, RAD1, RAD2, J, CRIT, IPHASE)

This routine outputs the radiation exclusion region data for each radiation environment.

TM	input	Time extent of the radiation exclusion region (sec)
RAD	input	Radial extent of the static exclusion region for boosters. Half width of static exclusion region for RVs (km)
RAD1	input	Center of the static exclusion region for RVs (km)
RAD2	input	Half length of static exclusion region for RVs (km)
J	input	Index of radiation environment
CRIT	input	Radiation environment criteria array
IPHASE	input	Flag to indicate RV or booster exclusion region
ICALL	data	Header flag

Routines called: ERRØUT

SUBRØUTINE LATE (T, HT, HM, RM, RB)

This routine defines the late time dust cloud dimensions for times after burst greater than one minute.

T	input	Time after burst (sec)
HT	output	Dust cloud top height (kft)
HM	output	Dust cloud middle height (kft)
RM	output	Dust cloud middle radius (kft)
RB	output	Dust cloud base radius (kft)
CØMMØN /THREAT/	input	I
CØMMØN /STUFF/	input	ARM, BRM, HMP, HMS, HMO, HTP, HTS, HTO, TER TPH, TRS

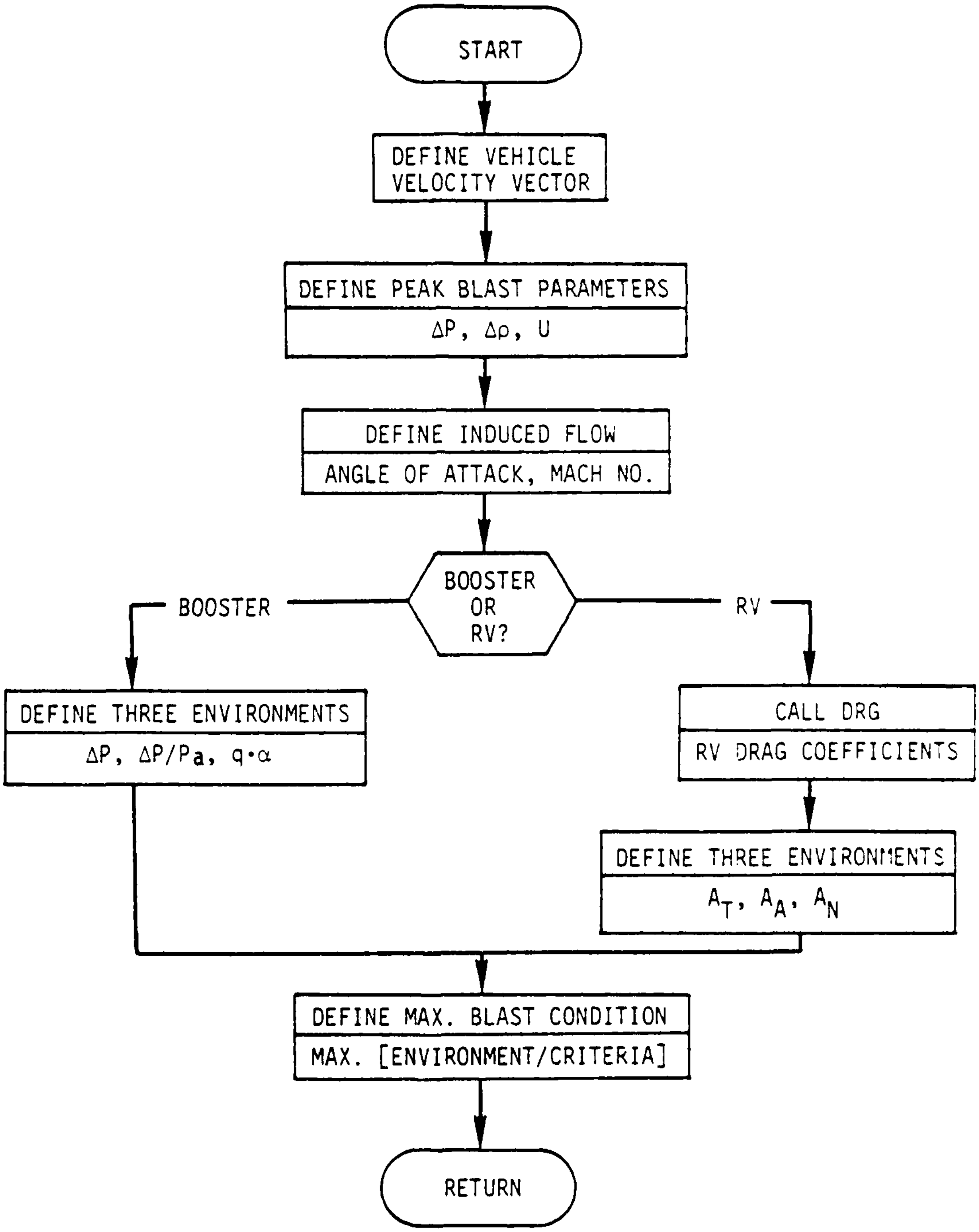
Routines called: RBASE

SUBRØUTINE LØAD (TB, RS, YD, X, Y; Z, TSTAR, Z1, IV, S, IM)

This routine computes blast environments at shock intercept and returns the maximum severity.

TB	input	Time before impact (RV) or after launch (booster) (sec)
RS	input	Shock front radius (kft)
YD	input	Effective blast yield (Mt)
X	input	Vehicle x coordinate relative to burst (kft)
Y	input	Vehicle y coordinate relative to burst (kft)
Z	input	Vehicle z coordinate relative to burst (kft)
TSTAR	input	RV burst time relative to sea level impact (sec)
Z1	input	Burst elevation (kft)
IV	input	Vehicle type
S	output	Maximum ratio of environment level to blast kill criteria
IM	output	Number of maximum environment
CØMMØN /HTRAJ/	input	TIM, VBAR, ANGL, MM
CØMMØN /WFRT/	output	ØPPK, ØDPK
CØMMØN /FRAT/	input	VL
Routines called:		TERPL, MATM62, SCALKT, WFPKØP, WFPKØD, WFPKV, ORG

SUBRØUTINE LØAD FLOW DIAGRR DIAGRAM



SUBRØUTINE LP (XMW2, GW)

This routine calculates the local properties at the boundary layer edge.

XMW2	input	Mach number times the sine squared of the angle between the shock and RV axis. (Presently the angle is 90°)
GW	input	Ratio of specific heats behind the shock
CØMMØN /LPNC/	output	All variables
CØMMØN /FSPC/	input	HT, XM8, P8PT8
CØMMØN /GPC/	input	G, GAM8, XJ, RGAS
CØMMØN /SPC/	input	PE, PEP8

SUBRØUTINE MATM62 (TTY, WSP, CS, WSR, WST)

This routine is a fit to the 1962 US Standard Atmosphere and was generated by the Air Force Weapons Laboratory.

TTY	input	Altitude (cm)
WSP	output	Pressure (dyne/cm^2)
CS	output	Sound speed in Air (cm/sec)
WSR	output	Density (g/cm^3)
WST	output	Temperature (°K)
NZ	data	Number of data values in the atmosphere data tables
RHØZ	data	Ambient sea level density (g/cm^3)
TABAT(1)	data	Gas constant (8.3144x10^7 ergs/mole/deg)
TABAT(2)	data	Radius of the earth (6.367488x10^8 cm)
TABAT(3)	data	Acceleration of gravity at sea level (9.80665x10^2 cm/sec^2)
TABAT(4)	data	Molecular weight of air at sea level (28.9644)
TABZ(22)	data	Atmosphere altitude data
TABL(21)	data	Atmosphere molecular scale temperature gradient (deg/cm)
TABT(22)	data	Atmosphere molecular scale temperature (°K/cm)
TABP(22)	data	Atmosphere pressure (dyne/cm^2)
CØNS	data	Combination of TABAT's CØNS = TABAT(3)*TABAT(4)*TABAT(2)**2/TABAT(1)

Routines called: IBY

SUBROUTINE MESAGE (MINDEX, M1, NØ, RNØ)

Writes error and key diagnostic messages

MINDEX	input	FØRMAT statement number for the desired message
M1	input	Index of the calling subroutine name stored in array LABEL in BLØCKDATA
NØ	input	Integer variable transferred to the output message
RNØ	input	Real variable transferred to the output message
CØMMØN /DTH/	input	LABEL

SUBRØUTINE MNCNCX (ICNCX)

This is a sub-executive routine used to calculate modified Newtonian normal and axial force coefficients for composite sphere-cone vehicles as a function of angle of attack with vehicle design variables used as parameters.

ICNGX	output	Flag indicating that drag coefficients were input
CØMMØN /BC/	input	TCDEG, SINTC, CØSTC, TANTC, RN, RB
CØMMØN /PTMC/	input	PI, XRAD
CØMMØN /DRAG/	input	NM
CØMMØN /DRAG/	output	CNØ, CXØ, ALPHA, XMACH, NA, NM
CØMMØN /FSPC/	output	XM8
PMACH	data	Mach numbers
PALPHA	data	Angle of attack values
IPM	data	Number of Mach numbers
IPA	data	Number of angles of attack

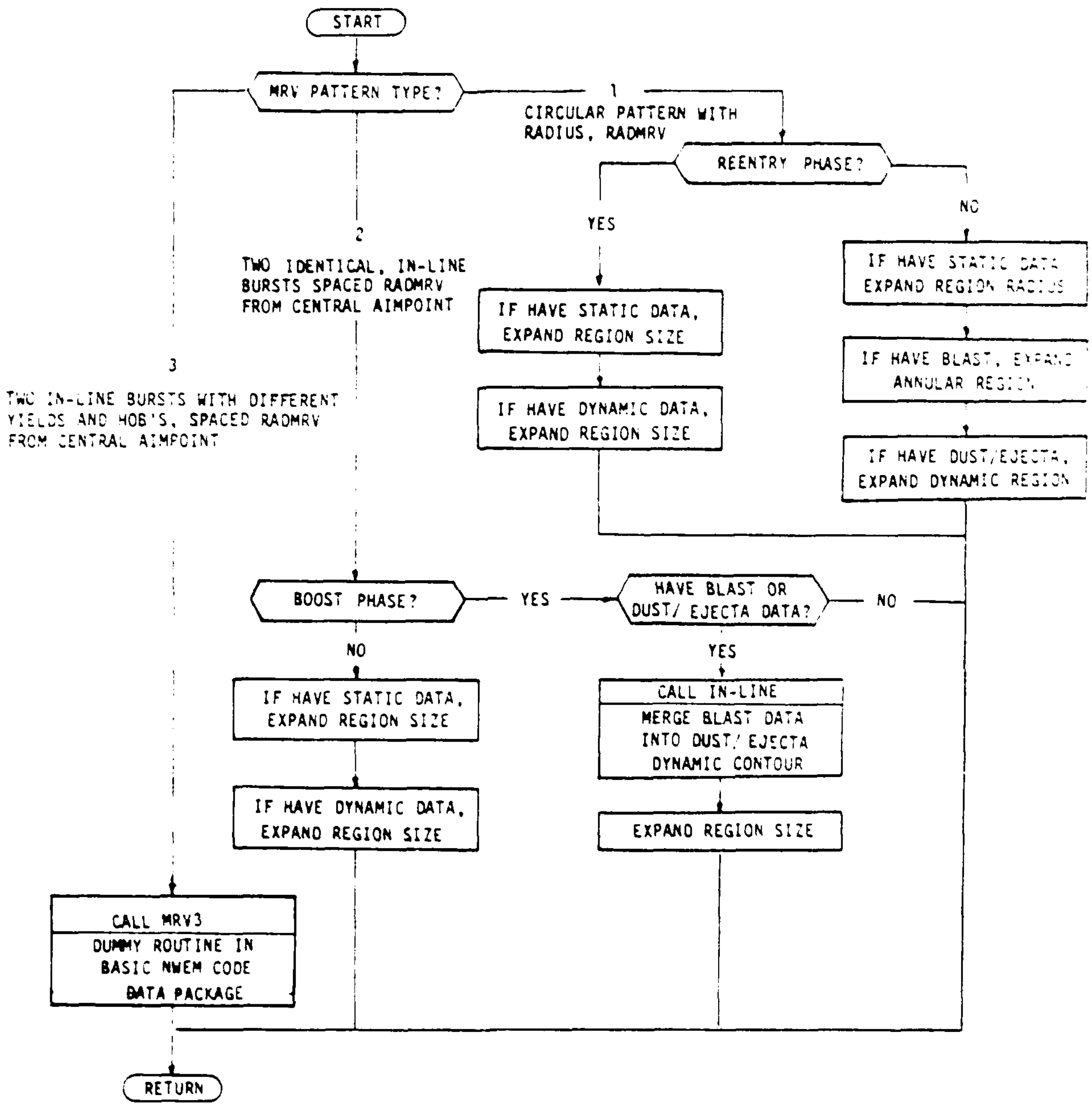
Routines called: CDPCMP

SUBRØUTINE MRVSUM (IPHASE, IPASS, IMRV, RADMRV, TMRV, AMRV)

Creates an exclusion region encompassing the individual burst contours for an MRV array. Static contours have a circular region for boost and elliptical for reentry. Blast contours are merged into the rectangular dynamic region. AMM units are used for all vehicles.

IPHASE	input	See /RAD/
IPASS	input	Program replication index for MRV option 3 1 - First pass -- first burst (downrange) 2 - Second pass -- second burst (uprange)
IMRV	input	Type of MRV pattern modeled. Three different exclusion region models are defined in order to minimize region sizes for different patterns 1 - Three or more bursts having identical yields and burst times. A circular contour is generated 2 - Two simultaneous, equal-yield, in-line, trajectory-plane bursts. A rectangular contour is generated 3 - Two different yield, different altitude, in-line bursts with the uprange burst delayed in time. Although coding for this option has been completed, it numerous logic paths have not been verified so it is not included at this time. A dummy routine, MRV3, is called if MRV=3.
RADMRV	input	Pattern radius for IMRV=1. Burst location on the patterns does not matter. One half the burst separation distance for IMRV=2 or 3. The two burst cases are centered about the nominal aimpoint used by AMM (NMi)
TMRV	input	Time separation of bursts for IMRV=3 (sec)
AMRV	input	Altitude of the second burst for IMRV=3 (ft)
CØMMØN /BST/	input	All
CØMMØN /BST/	output	All except, NBL, NFØ
CØMMØN /RVC/	input	All
CØMMØN /RVC/	output	All except NTM

SUBRØUTINE MRVSUM FLOW DIAGRAM



SUBRØUTINE MRV3 (IPHASE, IPASS, RADMRV, TMRV, AMRV)

Controls definition of MRV Option 3, currently a dummy routine.

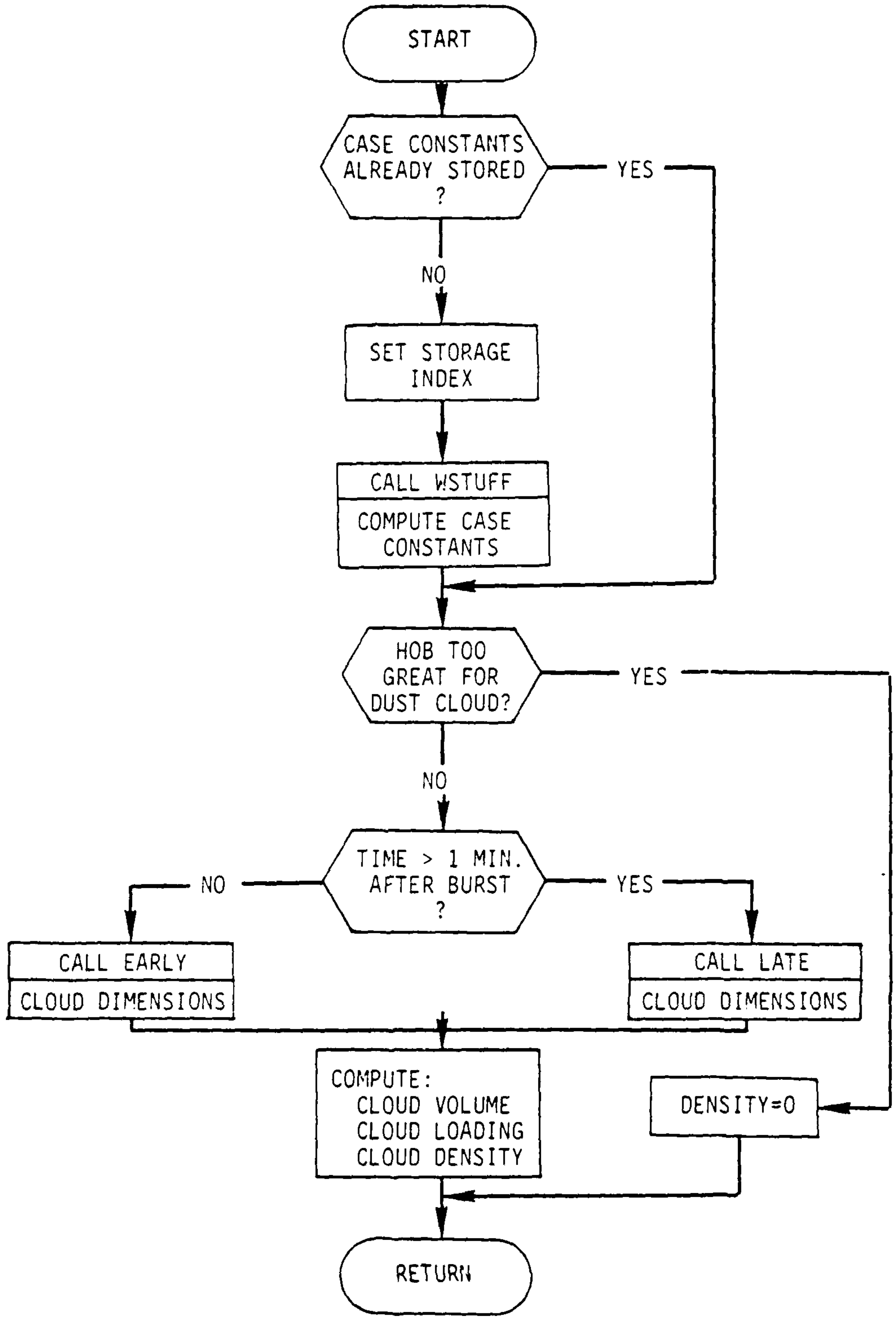
SUBRØUTINE NUCLD (T, W, SHØB, HT, HM, RM, RB, RHØ)

This routine controls the dust cloud size and density determination.

T	input	Time after burst (sec)
W	input	Burst yield (Mt)
SHØB	input	Burst scaled height-of-burst (ft/kt$^{1/3}$)
HT	output	Dust cloud top height (kft)
HM	output	Dust cloud middle height (kft)
RM	output	Dust cloud middle radius (kft)
RB	output	Dust cloud base radius (kft)
RHØ	output	Dust cloud density (g/cm^3)
CØMMØN /CØNVR/	input	CVD
CØMMØN /THREAT/	input	N, WØLD, SHØLD, KDUST
CØMMØN /THREAT/	output	I, N
CØMMØN /STUFF/	input	TER
CØMMØN /VØLLY/	output	V
CØMMØN /PARAM/	output	WD

Routines called: WSTUFF, EARLY, LATE, VØLUME, AIRMAS

SUBRØUTINE NUCLD FLOW DIAGRAM



SUBRØUTINE ØUTIN (IPASS)

This routine outputs various levels of input and associated variable values to define the input of the problem.

IPASS	input	Flag indicating pass number for MRV third type
CØMMØN /HTRNS/	input	All variables
CØMMØN /ITRNS/	input	ITYPE, NTRJ, IMRV, INEUT, IXRAY
CØMMØN /TRNS/	input	BLST1, BLST2, BLST3, DUST1, DUST2, DUST3, PEBB1, PEBB2, THER1, THERF, XNEUT1, XGM1, EMP1, RVHT, RVANG, RVCL, RVCYL, RVFL, YLD, XHØB2, XNEUTX, AFRAC, GAMDS, GAMPL, RADMAX, RADTIM, XTM1, XM2
CØMMØN /DLAG/	input	XCN, XCA, XA1, XTM2, NA, NM
CØMMØN /ØUT/	input	Q2, Q3, Q5, Q6, Q8, Q9, IQ1, IQ4, IQ7
CØMMØN /TRAJ/	input	All variables
CØMMØN /WPN/	input	FN, FX, FTDG, THERM
CØMMØN /XTITL/	input	LEVØUT

SUBRØUTINE ØUTRIT (JFLAG, IND, NDUM2)

Edits interim and final output from the radiation and exclusion region contour generation subroutines including common blocks /ØUT/, /RR1/, /RR2/, /STA/, /RRR/, and /WPN/.

IFLAG	input	Flag denoting the block of output desired 1 - CØMMØN /RRR/ 2 - CØMMØN /ØUT/ 3 - CØMMØN /RR1/ 4 - CØMMØN /RR2/ 5 - CØMMØN /SPA/ 6 - CØMMØN /WPN/ 7 - DUMMY
IND	input	Integer variable transfer to facilitate edit or include in edit
NDUM2	input	A second integer variable to facilitate edit or include in edit
CØMMØN /ØUT/	input	All variables
CØMMØN /RR1/	input	All variables
CØMMØN /RR2/	input	All variables
CØMMØN /RRR/	input	All variables
CØMMØN /STA/	input	All variables
CØMMØN /RAD/	input	All variables
CØMMØN /DTH/	input	NAME
CØMMØN /WPN/	input	NAME
KK	data	Flag permiting a heading for all detailed program output edit

Routines called: ERRØUT

SUBRØUTINE PTINT (H2, V2, G2, R2, T2, CD, Q8, RVAM, CØSG2, A1, V1, G1,
R1, T1, D1, E1, B1)

This routine performs the individual time step integration of the RV trajectory.

H2	input	Previous RV altitude (ft)
V2	input	Previous RV velocity (ft/sec)
G2	input	Previous RV angle to the local horizontal (radians)
R2	input	Previous RV ground range (ft)
T2	input	Previous time (sec)
CD	input	Drag coefficient
Q8	input	Dynamic pressure on RV during time step (slug/ft-sec^2)
RVAM	input	RV reference area divided by the mass (ft^2/slug)
CØSG2	output	Cosine of the RV angle to the local horizontal CØS(G2)
H1	output	Updated RV altitude (ft)
V1	output	Updated RV velocity (ft/sec)
G1	output	Updated RV angle to the local horizontal (radians)
R1	output	Updated RV ground range (ft)
T1	output	Update time (sec)
D1	output	Acceleration of RV along flight path (ft/sec^2)
E1	output	Time rate of change of RV altitude (ft/sec)
B1	output	Time rate of change of RV angle to the local horizontal (radian/sec)
CØMMØN /PTMC/	input	XMØ, RØ
DELT	data	Maximum integration time step (sec)
DVEL	data	Maximum velocity change over time step interval (ft/sec)

SUBRØUTINE PTLAST (JJ, KK, RSTEP)

Calculates lethal volume size along a path directed toward a surface point corresponding to the final remaining altitude in either the upper or lower half of the volume. SUBRØUTINES PT4, PT17, and PTMAX previously calculated volume dimensions at the other altitudes (times).

JJ	input	Environment index 1 - Neutrons 2 - Peak prompt gamma dose rate 3 - X-rays 4 - Thermal radiation
KK	output	Provision for adding a flag calling the error message routine, MESAGE, from RADIAT. Not currently used
RSTEP	input	Range step size used to find the range to the criterion level by iterative convergence (km)
CØMMØN /RR1/	output	T, RH, R, RDEL, A, PERCNT
CØMMØN /RAD/	input	CRIT, ABURST, AUPDN, ALAST, IMAX
APØINT		Altitude of lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)
RNGE		Range to the lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)
Routines called:		RHØX, FENV, TRAJEC

See PTMAX flow diagrams for similar function flow of PTLAST

SUBRØUTINE PTMASS (QH1, QH1, QV1, QM, QA, QRN, QRB, QTC, QRUFF, QACYL, QAFLAR, QHCØN, QHCYL, QHFLAR)

This routine is a sub-executive routine which directs the calculation of the RV trajectory data and drag coefficients.

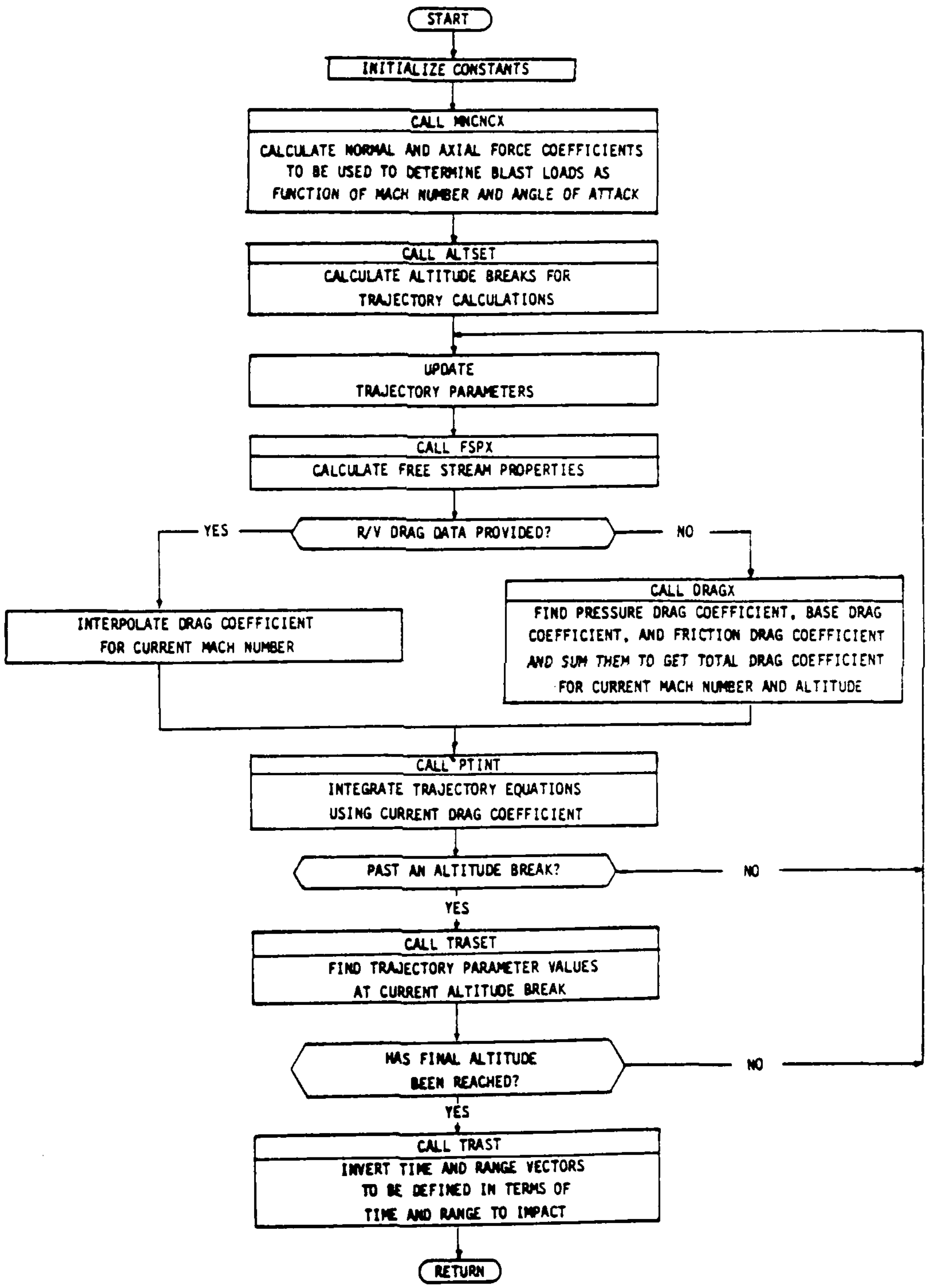
QH1	input	RV initial reentry altitude (ft)
QG1	input	RV initial reentry angle (deg)
QV1	input	RV initial reentry velocity (ft/sec)
QM	input	RV mass (slugs)
QA	input	RV reference area (ft^2)
QRN	input	RV nose radius (in)
QRB	input	RV base radius (in)
QTC	input	RV cone half angle (deg)
QRUFF	input	RV surface roughness (in)
QACYL	input	RV cylinder half angle (deg)
QAFLAR	input	RV flare half angle (deg)
QHCØN	input	RV cone length along axis (in)
QHCYL	input	RV cylinder length along axis (in)
QHFLAR	input	RV flare length along axis (in)
CØMMØN /TRAJ/	input	NSAVE
CØMMØN /TRAJ/	output	TIME, RANGE, ALTX, VEL, FPA
CØMMØN /DRIDR/	output	XTR, ISTPAS
CØMMØN /DRAG/	input	CXØ, XMACH, NM
CØMMØN /DRAG/	output	WN
CØMMØN /BC/	output	All variables
CØMMØN /FSPC/	input	XM8, Q8
CØMMØN /FSPC/	output	H2, V2
CØMMØN /GPC/	output	CP8, G, GAM8, XJ, PR, RGAS

CØMMØN /PTMC/	output	PI, XRAD, AMØ, RØ

Routines called: MNCNCX, ALTSET, FSPX, FSP, DRAGX, TERPL, PTINT, TRAJET, TRAST

QACYL, QAFLAR, QHCØN, QNCYL AND QHFLAR are not presently used in this version of the NWEM code

SUBROUTINE PTMASS FLOW DIAGRAM



SUBRØUTINE PTMAX (JJ, KK, ASTART, RSTEP, ITMAX)

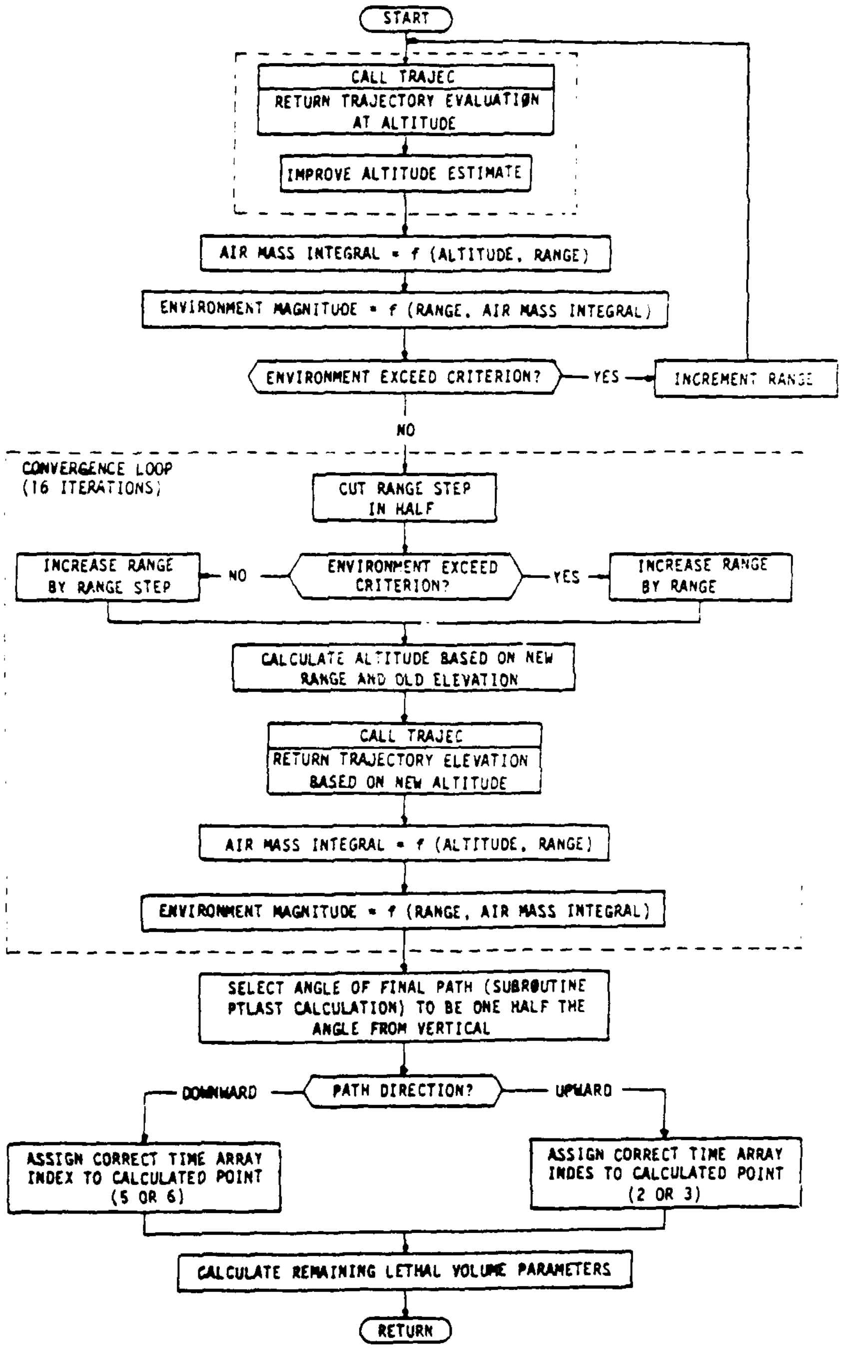
Calculates lethal volume size for the altitude at which the trajectory grazes the surface, either above or below the burst altitude. Follows calculation of top, bottom, and burst altitude dimensions by SUBRØUTINES PT4 and PT17. Called by RADIAT except for a surface burst or if the grazing trajectory below the burst point were located below the earth's surface.

JJ	input	Environment index 1 - Neutrons 2 - Peak prompt gamma dose rate 3 - X-rays 4 - Thermal radiation
KK	output	Provision for adding a flag calling the error message routine, MESAGE, from RADIAT. Not currently used
ASTART	input	Initial estimate of grazing trajectory contact point altitude based on burst and either top or bottom altitudes of the lethal volume
RSTEP	input	Range step size used to find the criterion level by iterative convergence (km)
ITMAX	input	Maximum number of time steps, i.e., the index of the bottom of the lethal volume. Used to define the time index of the point determined for a grazing trajectory below the burst point
CØMMØN /RR1/	output	T, RH, R, RDEL, A, PERCNT
CØMMØN /RAD/	input	CRIT, ABURST, PI, AUPDN, IMAX
CØMMØN /RAD/	output	ALAST
ALT		Altitude of lethal volume surface point being defined. Changes as location estimate is refined during the iteration (km)
RNGE		Range to the lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)

ELEV	input	Elevation angle of the trajectory w.r.t. the local horizontal. Changes as location estimate is refined during the iterations (radians)

Routines called: PHØX, FENV, TRAJEC

SUBROUTINE PTMAX FLOW DIAGRAM *



* Functional flow for PT17, PT4 and PTLAST is similar.

SUBRØUTINE PT17 (JJ, KK, ITMAX)

Calculates lethal volume size along the ground zero (vertical axis) in either direction. If the surface is encountered before the downward size is determined, the range to a point on the earth's surface is determined neglecting radiation scattering effects from the surface itself.

JJ	input	Environment index 1 - Neutrons 2 - Peak prompt gamma dose rate 3 - X-rays 4 - Thermal radiation
KK	output	Flag directing that the calculation be terminated after MESAGE is called to print a message that the problem does not converge
ITMAX	output	Index of final time point (see CØMPAR)
CØMMØN /RR1/	output	T, RH, R, RDEL, A, PERCNT
CØMMØN /RAD/	input	CRIT, ABURST, AUPDN, ICHK
APØINT		Altitude of lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)
RNGE		Range to the lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)
STEPA		Altitude-dependent estimate of range step size sufficiently small that an iterative convergence to the correct lethal volume size is possible (km)
RSTEP		Range step size used to find the exact range to the criterion level by iterative convergence (km)
Routines called:		RHØX, FENV, TRAJEC, MESAGE

See PTMAX flow diagrams for similar function flow of PT17

SUBRØUTINE PT4 (JJ, KK)

Calculates the lethal volume size at the burst altitude and assigns the descriptive data to index 4 in the time array.

JJ	input	Environment index 1 - Neutrons 2 - Peak gamma dose rate 3 - X-rays 4 - Thermal radiation
KK	output	Flag directing that RADIAT call MESAGE to print an error message indicating that the problem cannot converge to the criterion environment level. It then terminates the radiation environment calculation
CØMMØN /RR1/	output	T, RH, R, RDEL, A, PERCNT
CØMMØN /RAD	input	CRIT, ABURST, ICHK
RSTEP		Range step size used to find the exact range to the criterion level by iterative convergence. An estimate of one-half the exoatmospheric range to the criterion level is used initially for burst altitudes above 20 km and an altitude-varying size at lower altitudes (km)
RNGE		Range to the lethal volume surface point being defined. Changes as location estimate is refined during the iterations (km)
Routines called:		RHØX, FENV, TRAJEC

See PTMAX flow diagrams for similar function flow of PT4

SUBRØUTINE QUAD (X, XT, YT, Y)

This is a quadratic interpolation routine for three point pair wise arrays. No search is performed, nor is extrapolation done. End points values are returned.

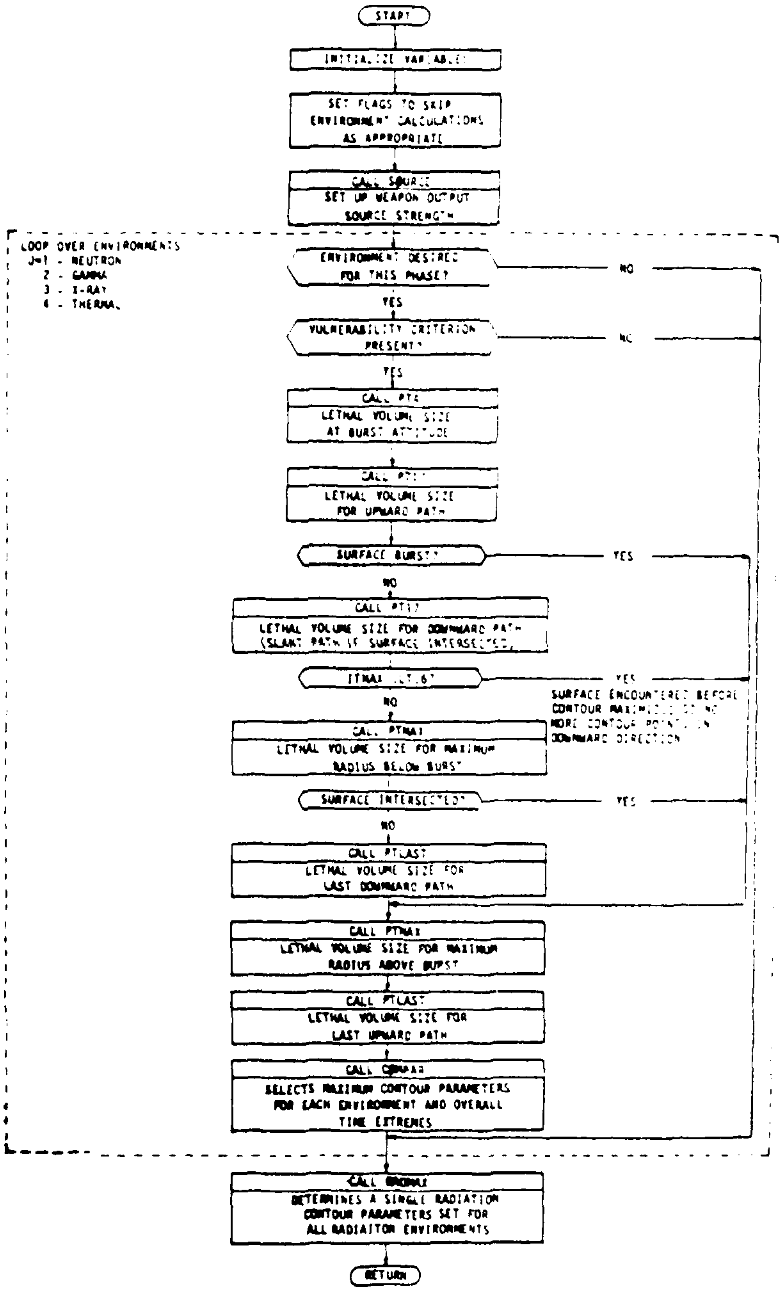
X	input	Independent variable
XT	input	Independent variable array
YT	input	Dependent variable array
Y	output	Dependent variable value

SUBRØUTINE RADIAT (IP, IPASS, AB, CC1, CC2, CC3, CC4)

Sub-executive routine called by the main program to process radiation environments. Calculates lethal volumes and exclusion regions at up to 7 times for each radiation environment. Currently evaluates four environments: prompt neutron fluence, prompt gamma peak dose rate, X-ray fluence, and thermal radiation fluence. A single encompassing exclusion region is returned for either boost or reentry phase.

IP	input	Flight phase index, equal to IPHASE 2 - Boost phase 4 - Reentry phase
IPASS	input	Flag indicating which burst is being calculated for MRV Option 3 0 - First burst (downrange w.r.t. RV launch point) 1 - Second burst (uprange w.r.t. RV launch point)
AB	input	Burst altitude (ft)
CC1	input	Environment criterion for neutrons, equal to CRIT(1) (neutrons/cm^2)
CC2	input	Environment criterion for prompt gammas, equal to CRIT(2) (rad(Si)/sec)
CC3	input	Environment criterion for X-rays, equal to CRIT(3) (cal/cm^2)
CC4	input	Environment criterion for thermal radiation, equal to CRIT(4) (cal/cm^2)
CØMMØN /RRR/	output	TIMAX, TIMIN, JINDEX, MAXIN, ILØØPS, ITM
CØMMØN /RR1/	output	R, A
CØMMØN /RAD/	output	CRIT, ABURST, PI, AUPDN, ISKIP, IPHASE, ICHK
CØMMØN /RAD/	input	IMAX
CØMMØN /XTITL/	input	LEVØUT
STEPA		Estimated step size defined such that the scheme for environment definition will converge
Routines called:		SØURCE, ØUTRIT, MESAGE, PT4, PT17, PTLAST, PTMAX, CØMPAR, RADMAX

SUBRØUTINE RADIAT FLOW DIAGRAM

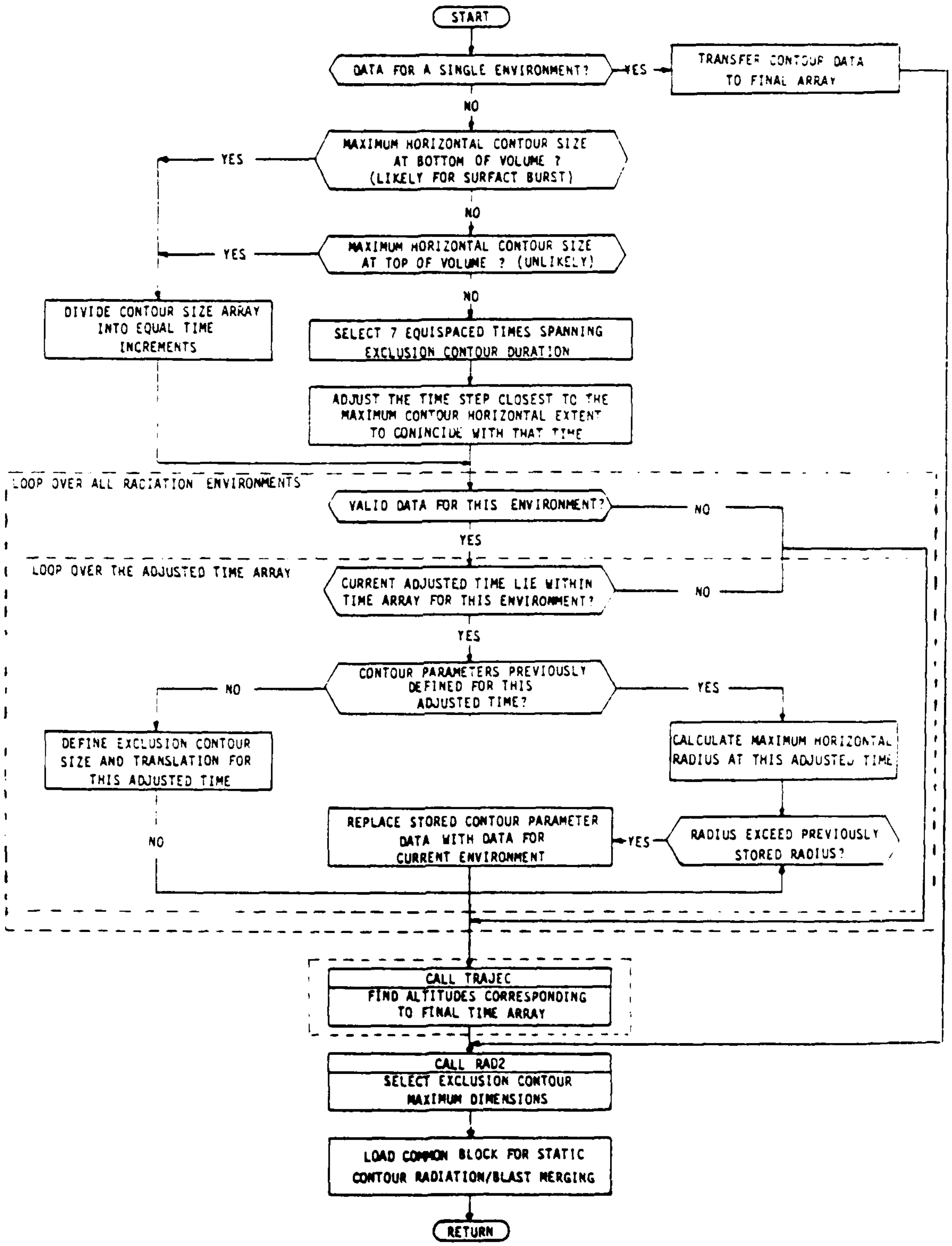


SUBRØUTINE RADMAX (IPHASE, NENV, ISKIP)

Determines the maximum surface exclusion region resulting from all radiation environments over all times.

IPHASE	input	Flight phase index 2 - Boost phase 4 - Reentry
NENV	input	Total number of radiation environments --- currently 4
ISKIP	input	Flag for each environment, set equal to 1 if the environment is to be skipped (environment index order as for CRIT)
CØMMØN /DTH	input	NAME
CØMMØN /XTTL/	input	LEVØUT
CØMMØN /RRR/	input	All variables
CØMMØN /RR1/	input	All except PERCNT
CØMMØN /RR2/	output	All variables
CØMMØN /STA/	output	All variables
FRXT		Time index plus fractional increment towards the next index that the time corresponding to the maximum horizontal radius (over all environments) occupies in the final time array. Used to adjust one of the final time array points, TEX(I), to coincide with the time of maximum horizontal radius
FRAX	input	Linear fraction of a time interval T(I)-T(I+1) that TEX(J) occupies. Defined by SUBRØUTINE TERP such that linear interpolation of the exclusion contour data for the environment in question can be performed to compare it with data from other environments at the same final time so that the maximum exclusion contour parameters can be obtained
Routines called:		TERP, RAD2, ØUTRIT

SUBRØUTINE RADMAX FLOW DIAGRAM



SUBRØUTINE RAD2 (NAXITM, IPHASE)

Selects the maximum values of radiation exclusion region data, identifying each causative environment. Converts exclusion region times to negative times.

MAXITM	input	Maximum number of times specified. Redefined as 7 in RADMAX if 2 or more radiation environments have been calculated
IPHASE	input	Flight phase 2 - Boost 4 - Reentry
CØMMØN /RR2/	input	TEX, RHEX, RUPEX, RDNEX, NAMEX
CØMMØN /RR2/	output	TEX, TMIN, TMAX, RHMAX, RUPMIN, RDNMAX, NAMET1, NAMET2, NAMEH, NAMEU, NAMED

FUNCTIØN RBASE (T)

This routine defines the dust cloud base radius after fireball breakaway (kft).

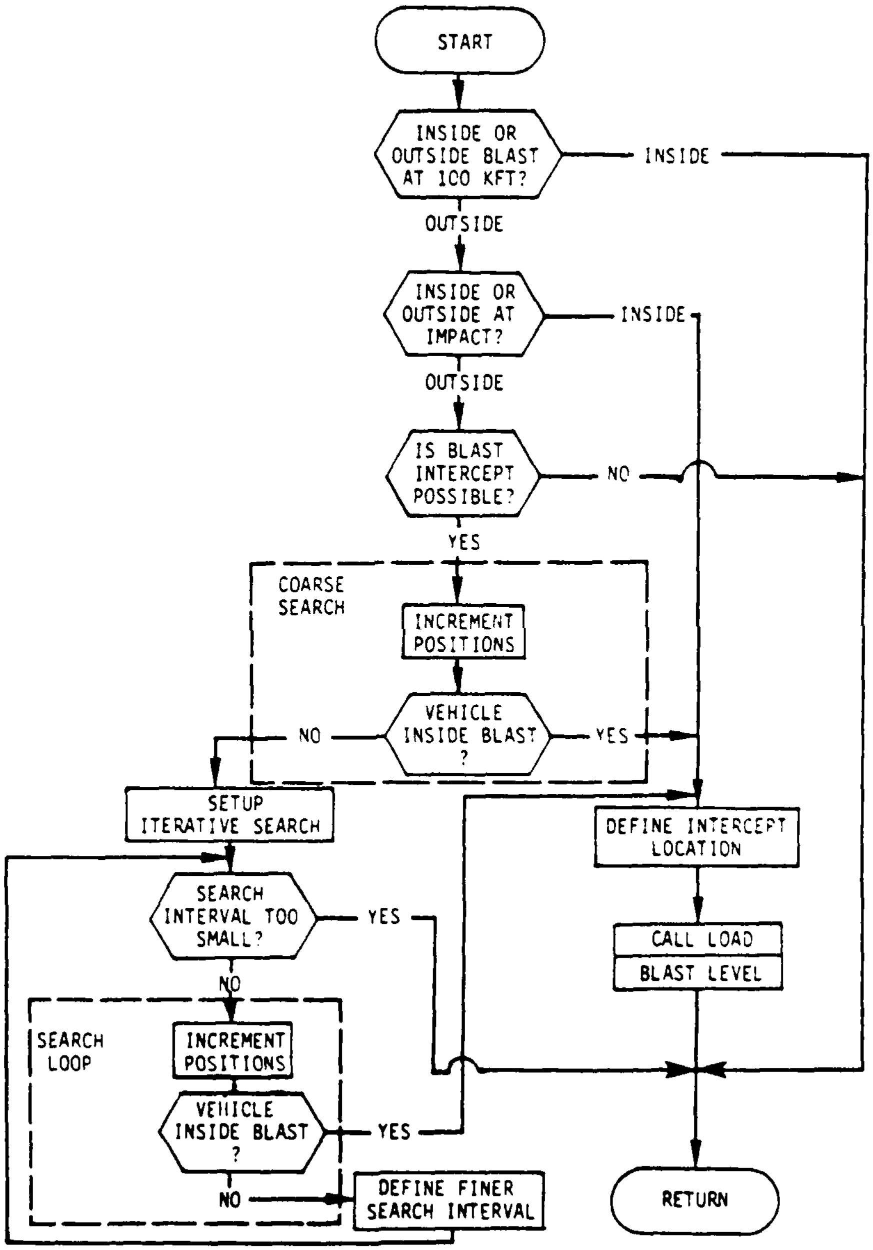
T	input	Time after burst (sec)
CØMMØN /THREAT/	input	I
CØMMØN /STUFF/	input	ABO, BBO, RBC, RBS, TBC, TBS

SUBRØUTINE REENTR (T, X2, Y2, Z2, Z0 , Z1 , YDT, YSTAR, TSTAR, S, IV, IM)

This routine controls search for RV intercepts with shock waves and **defines the resulting environment severity.**

T	input	Time of RV2 impact after RV1 burst (sec)
X2	input	Position of RV2 burst relative to RV1 burst, x component (kft)
Y2	input	Position of RV2 burst relative to RV1 burst, y component (kft)
Z2	input	RV2 burst elevation (kft)
Z0	input	Ground plane elevation (kft)
Z1	input	RV1 burst elevation (kft)
YDT	input	Effective blast yield (Mt)
YSTAR	input	Y offset of RV2 due to burst elevation above sea level (normal trajectory termination) (kft)
TSTAR	input	Time offset (along trajectory) of RV2 due to burst elevation above sea level (normal trajectory termination) (sec)
S	output	Environment severity. Ratio of intercepted environment to kill criteria.
IV	input	Vehicle type: 2 for booster, 4 for RV
IM	output	Number of blast environment with the maximum severity.
CØMMØN /HTRAJ/	input	TBP, RBP, ABP, NTRAJ
Routines called:		TERPL, RSHK, VLØC, LØAD

SUBRØUTINE REENTR FLOW DIAGRAM



SUBRØUTINE REXBDY (XM, REX2RN)

This routine calculates the local Reynold's number at a position along the RV axis two times the RV nose radius.

XM	input	Mach number
REX2RN	output	Local Reynolds number at a position along the RV axis twice the RV nose radius
CØMMØN /BC/	input	TCRAD, SINTC, CØSTC, TANTC, RN
CØMMØN /FSPC/	input	P8, HT
CØMMØN /GPC/	input	G, GAM8, XJ
CØMMØN /PTMC/	input	PI
GAM3	data	Coefficient in correlation at the elevated temperature (.718)

FUNCTIØN RHØX (Z1, Z2, R)

Determines the air mass integral in gm/cm^2 between two points. Based upon flat earth geometry. If the two points are coaltitude, MATM62 is called to return air density.

Z1	input	Altitude of first point (km)
Z2	input	Altitude of second point. Z1 and Z2 can be in any order (km)
R	input	Slant range between Z1 and Z2 (km)
Z(92)	data	Altitude table (kft)
RHØDZ(92)	data	Vertical air mass integral from 0 kft to the corresponding altitude, Z, (gm/cm^2)

Routines called: TERPL, MATM62

FUNCTIØN RSHK (TIM, Z2 , Z1 , YLD)

This routine calculates the shock radius (kft) from the burst point. It is based on the AFWL 1 kt standard.

TIM	input	Time after burst (sec)
Z2	input	Elevation of the point of interest (kft)
Z1	input	Burst elevation (DUMMY)
YLD	input	Burst yield (Mt)
B	data	Constant for curve fit
C	data	Constant for curve fit
CZ	data	Constant for curve fit
BZ	data	Constant for curve fit
TA3	data	Constant for curve fit
TPWR1	data	Constant for curve fit
TPWR2	data	Constant for curve fit

Routines called: SCALKT

SUBRØUTINE SCALKT (H, HFPT, WB, VSCALE, DSCALE, TSCALE, CSCALE, PSCALE)

This routine sets up scale factors for modified Sachs scaling of 1 kT sea level data.

H	input	Burst elevation (dummy)
HFPT	input	Elevation of point of interest (cm)
WB	input	Burst yield (kt)
VSCALE	output	Velocity scale factor
DSCALE	output	Density scale factor
TSCALE	output	Time scale factor
CSCALE	output	Length scale factor
PSCALE	output	Pressure scale factor
CØMMØN /CØNST/	input	THRD, P1, C1, R1
Routines called:		MATM62

SUBRØUTINE SIZER (EM)

This routine sizes the grid for subsequent definition of intercepted kinetic energy points.

EM	output	Trajectory slope $\left(\frac{dz}{dR}\right)$ at cloud top
CØMMØN /BURST/	input	HT, HM, RM, HBRV
CØMMØN /DIMEN/	output	NY, NX, YMAX, DY, DX
CØMMØN /HTRAJ/	input	AA, RR, NN
Routines called:		SLØPE, TERPL

FUNCTIØN SLØPE (Z)

This routine defines the vehicle trajectory slope $\left(\frac{dz}{dR}\right)$ at a given **altitude.**

Z	input	Altitude (kft)
CØMMØN /HTRAJ/	input	AA, RR, NN

SUBROUTINE SØLV (TC, XM, BR, C, N, ANS)

This routine performs the third and fourth order interpolations required by the correlation function of the drag coefficient.

TC	input	RV cone half angle (deg)
XM	input	Mach number
BR	input	RV bluntness ratio or log of the bluntness ratio
C	input	Correlation data
N	input	Order of the correlation fit in RV cone half angle
ANS	output	Correlation function result

SUBRØUTINE SØURCE

Generates weapon radiation output source strengths using data from /WPN/ to load /ØUT/ so that the radiation environment at a point can be calculated by FENV. Converts air transmission data in TX, TN, and TG arrays to $\log_{10}$ so that semi log interpolation can be used.

CØMMØN /ØUT/	input	TX, TN, TG, NØX, NØN, NØG
CØMMØN /ØUT/	output	SX, TX, SN, TN, SG, TG, NØX, NØN, NØG
CØMMØN /RAD/	input	ISKIP
CØMMØN /RAD/	output	WØUT
CØMMØN /WPN/	input	All variables
CØMMØN /WPN/	output	FN, FG, FX, FT, DELTG

SUBRØUTINE SP

This routine calculates the static pressure and static pressure to ambient pressure ratio for the RV drag coefficient calculation.

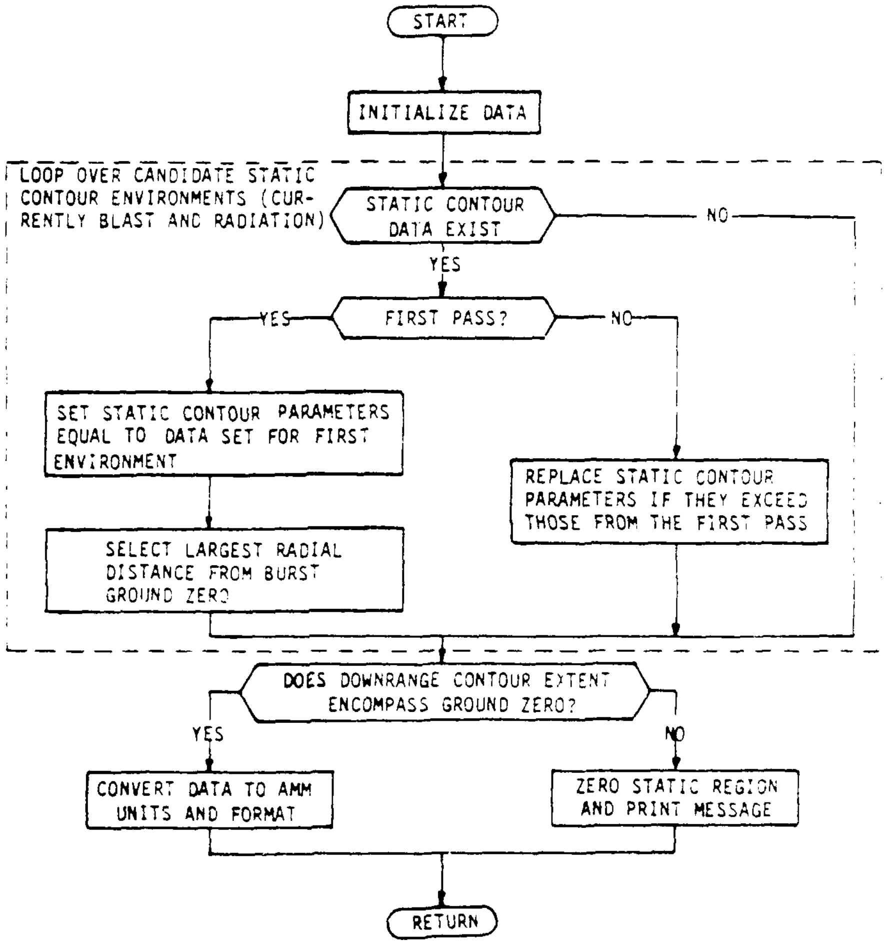
CØMMØN /BC/	input	SINTC
CØMMØN /FSPC/	input	P8, XM8
CØMMØN /GPC/	input	GAM8
CØMMØN /SPC/	output	All variables

SUBRØUTINE STATIC

Combines the overall radiation static contour with the negative time (i.e., launch before burst) portion of the blast contour to get a net static region exclusion contour for the boost phase. Dust and ejecta are assumed non-limiting at negative times. If the exclusion region does not encompass ground zero, it is assumed that increasing the size of the region to include all the projected area would be excessive since an offset region is prohibited by AMM, so a message is printed and no static contour is produced. This limits the current modeling to low altitude bursts whose lethal volumes reach the surface.

CØMMØN /BST/	output	FØRADI, FØTIMS
CØMMØN /DTH/	input	NAME
CØMMØN /STA/	input	All variables
CØMMØN /XTITL/	input	LEVØUT
IPASS		Flag indicating environments being processed or that have been processed, either 1 or 2 at this time. Note, this is different from IPASS as used in the main program
RMAX	output	Maximum distance (positive) from ground zero to any point on the exclusion contours, equal to FØRADI when converted to nmi if ground zero is encompassed (km)
NRMAX		Label of limiting environment (radiation or blast) (hollerith variable)
RTEST	output	If ground zero is not encompassed, the closest approach of the contour to ground zero is output by MESAGE (km)
Routines called:		MESAGE, ØUTRIT

SUBRØUTINE STATIC FLOW DIAGRAM



AD-A086 223 TRW DEFENSE AND SPACE SYSTEMS GROUP REDONDO BEACH CA F/G 18/3
NUCLEAR WEAPON ENVIRONMENT MODEL. VOLUME II. COMPUTER CODE USER--ETC(U)
FEB 79 R M SAQUI, T A MAZZOLA, J R HOBART DNA001-78-C-0340
UNCLASSIFIED TRW-34001-6006-RU-00 DNA-4868F-2 NL

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SUBRØUTINE STATRV

Converts the static exclusion contour parameters for the radiation environment (only static region contributor) to AMM output format. The duration of the region is overestimated if the lethal volume doesn't intersect the surface since time offset is not permitted.

CØMMØN /RVC/	output	FRSLEN, FRSWID, FRSCEN, TIMST
CØMMØN /STA/	input	All
CØMMØN /XITIL/	input	LEVØUT
Routines called:		ØUTRIT

FUNCTIØN TBREAK (W)

This routine provides a characteristic time (min) used in definition of the dust cloud base radius.

W	input	Burst yield (Mt)
WMIN	data	Minimum yield (.0353)
WMAX	data	Maximum yield (200.0)
WB	data	Yield array
TB	data	Characteristic time array

SUBRØUTINE TERP (TGIVN, III, J, IFIND, FRAX)

Finds the index of the lower bound in the T array interval that TGIVN is within plus the linear fraction of the interval to TGIVN. T is monotonically decreasing and TGIVN lies within the T array. The index, IFIND, and fraction, FRAX, are used to interpolate region parameters which vary with T.

TGIVN	input	Time between lethal volume point and the surface which lies within the time array, T(I,J) (sec)
III	input	Maximum time index, I, of the time array, T(I,J)
J	input	Radiation environment index 1 - Neutrons 2 - Prompt gamma 3 - X-rays 4 - Thermal radiation
IFIND	output	Lower bound index of the time array interval containing TGIVN
FRAX	output	Linear fraction of the interval T(I+1,J) - T(I,J) corresponding to the time between T(I,J) and TGIVN
CØMMØN /RR1/	input	T

FUNCTIØN TERPL (UX, X, Y, N, NF1, NF2)

This function is a linear interpolation routine for pair wise arrays. For a given set of array data and a value somewhere in the range of the independent variable, it returns the associated dependent value by linearly interpolating in the data arrays. For a value outside the independent variable's range the function returns a linearly extrapolated value or the end point value.

UX	input	Input value of the independent variable
X	input	Independent variable array in ascending order
Y	input	Dependent variable array
N	input	Number of data values
NF1	input	Interpolation flag for index value in independent array (0/1 - unknown/known)
NF2	input	Extrapolation flag (0/1 - linear extrapolation/end value)

Routine called: IBY

FUNCTIØN TERPL2 (UX, UY, X, Y, Z, NX, NY, NF)

This function is a linear interpolation routine for two dimensional interpolation in an array. For a given set of array data and set of values somewhere in the ranges of the independent variables, it returns the associated dependent value by linearly interpolating in the data arrays. For values outside the ranges of the independent variables the function returns a linearly extrapolated value or the end point value.

UX	input	Input value of first independent variable
UY	input	Input value of second independent variable
X	input	First independent variably array in ascending order
Y	input	Second independent variable array in ascending order
Z	input	Two dimension dependent variably array
NX	input	Number of data values of first independent variable
NY	input	Number of data values of second independent variable
NF	input	Extrapolation flag (0/1 - linear extrapolation/ end values)

Routines called: IBY

SUBRØUTINE TNFR (N, X, Y)

This routine transfers data from one array to another array.

N	input	Number of data to be transferred
X	input	Data array to be transferred from
Y	output	Data array to be transferred to

SUBRØUTINE TØNSET

This routine determines the altitude at which turbulence comes onto the RV body for the drag calculation.

CØMMØN /DRIDR/	output	ITJF
CØMMØN /BC/	input	TCDEG, TCRAD, SINTC, CØSTC, RN, RB
CØMMØN /FSPC/		This common is used in a temporary data passing mode during iterations to determine turbulent onset attitude
CØMMØN /LPNC/	input	XME2, REFT2
CØMMØN /GPC/	input	GAM8, RGAS
CØMMØN /TRNSC/	input	LAMINR
CØMMØN /TRNSC/	output	LAMINR, XKTR
CØMMØN /PTMC/	input	PI
GAM1	data	Coefficient in correlation equation for local Reynolds number (901000.)
GAM2	data	Coefficient in correlation equation for local Reynolds number (-0.784)
I2	data	Constant 2 used in iteration scheme
Routines called:		ERRØUT, REXBDY, TPPTID, TERPL, RSP, FNFME, FNFRE

SUBRØUTINE TRAJEC (IPHASE, MØDE, AAA, RD, TT, ELEV, VEL)

Returns trajectory data for either boost or reentry phase after entering with altitude or time interval to the surface. Data generated consist of time to surface (positive), ground range along the earth's surface, altitude, velocity, and angle with respect to the horizontal. A warning message is written if the time or altitude is outside the array bounds and extrapolation is used to obtain the data.

IPHASE	input	Flight phase - not currently used since trajectory data are stored and used in an identical manner for each phase 2 - Boost 4 - Reentry
MØDE	input	Flag indicating entry variable 1 - Enter with altitude 2 - Enter with time to surface
AAA	input or output	Altitude (km)
RD	output	Ground range between trajectory point and the surface. Approximately equal to a horizontal range for the distances involved. (km)
TT	input or output	Flight time between surface and the trajectory point (sec)
ELEV	output	Elevation angle with respect to the local horizontal (radians)
VEL	output	Vehicle velocity (km/sec)
ALT	output	Altitude, AAA, (with units changed) printed by MESAGE if the altitude is outside the /TRAJ/ array bounds (ft)

Routines called: MESAGE, TERPL

SUBRØUTINE TRASET (H2, ALT, D1, E1, B1, T2, V2, G2, CØSG2, R2, TIME,
VEL, ANGL, RANGE)

This routine performs the time step integration of the RV trajectory at the altitude break points.

H2	input	Previous RV altitude (ft)
ALT	input	Altitude break point (ft)
D1	input	Acceleration of RV along flight path (ft/sec^2)
E1	input	Time rate of change of RV altitude (ft/sec)
B1	input	Time rate of change of RV angle to the local horizontal (radian/sec)
T2	input	Previous time (sec)
V2	input	Previous RV velocity (ft/sec)
G2	input	Previous RV angle to the local horizontal (radian)
CØSG2	input	Cosine of the RV angle to the local horizontal CØS(G2)
R2	input	Previous RV ground range (ft)
TIME	output	Time at altitude break point (sec)
VEL	output	RV velocity at altitude break point (ft/sec)
ANGL	output	RV angle to the local horizontal at altitude break point (deg)
RANGE	output	RV ground range at altitude break point (NMi)
CØMMØN /PTMC/	input	XRAD, RØ

SUBRØUTINE TRAST (TIME, RANGE, NSAVE)

This routine inverts the order and value of the calculated time and range arrays of the RV trajectory.

TIME	input output	RV trajectory time data (sec)
RANGE	input output	RV trajectorv ground range (NMi)
NSAVE	input	Number of RV trajectory data

SUBRØUTINE TRPTID

This routine computes the laminate turbulent transition point for the drag calculation in the non-coupled mode and through TØNSET.

CØMMØN /DRIDR/	output	XTR
CØMMØN /BC/	input	TCDEG, TCRAD, SINTC, CØSTC, RN RB
CØMMØN /FSPC/	input	XM8
CØMMØN /LPNC/	input	XME2, REFT2
CØMMØN /TRNSC/	output	LAMINR, RNRTR
CØMMØN /PTMC/	input	PI
REXMIN	data	Minimum Reynolds number allowed for transistion (5×10^5)
XKTR	data	Transition point parameter constant (41043.)
Routines called:		FNFME, FNFRE

SUBRØUTINE VLØC (TB, X, Y, Z, X2, Y2, Z2 , YSTAR, TSTAR, IV)

This routine locates the vehicle at the given time.

TB	input	Time to burst pt (RV) or time since launch (booster) (sec)
X	output	Vehicle location, x coordinate (kft)
Y	output	Vehicle location, y coordinate (kft)
Z	output	Vehicle location, z coordinate (kft)
X2	input	Burst or launch point, x coordinate (kft)
Y2	input	Burst or launch point, y coordinate (kft)
Z2	input	Burst or launch point, z coordinate (kft)
YSTAR	input	Trajectory range offset due to RV burst above sea level (kft)
TSTAR	input	Trajectory time offset due to RV burst above sea level (kft)
IV	input	Vehicle type: 2 for booster, 4 for RV
CØMMØN /HTRAJ/	input	T, RNG, ALT, N
Routines called:		TERPL

SUBROUTINE TRPTTJ

This routine computes the laminar to turbulence transition point for the drag calculation in the coupled mode.

CØMMØN /DRIDR/	output	XTR
CØMMØN /BC/	input	TCDEG, TCRAD, SINTC, CØSTC, RN, RB
CØMMØN /FSPC/	input	XM3
CØMMØN /LPNC/	input	XME2, REFT2
CØMMØN /TRNSC/	output	LAMINR, RNRTR
CØMMØN /PTMC/	input	PI
REXMIN	data	Minimum Reynolds number allowed for transition (5×10^5)
Routines called:		FNFME, FNFRE

FUNCTIØN VØLUME (T, HT, HM, RM, RB)

This routine defines the dust cloud volume (kft^3).

T	input	Time after burst (sec)
HT	input	Dust cloud top height (kft)
HM	input	Dust cloud middle height (kft)
RM	input	Dust cloud middle radius (kft)
RB	input	Dust cloud base radius (kft)
CØMMØN /THREAT/	input	I
CØMMØN /STUFF/	input	TLØ
PI	data	π (3.1415927)

FUNCTIØN WFPKØD (DUMMY)

This routine defines peak overdensity at shock front in g/cm^3.

DUMMY	input	Dummy argument
CØMMØN /WFRT/	input	ØPPK
RHØZ	data	Density of air at sea level (1.22E-3 g/cm^3)
Routines called:		AIR

FUNCTIØN WFPKØP (R)

This routine defines peak overpressure at the shock front in dynes/ cm^3.

R	input	Shock front radius (cm)
AC	data	Constant for curve fit
AQ	data	Constant for curve fit
ASTAR	data	Constant for curve fit

FUNCTIØN WFPKV (DUMMY)

This routine defines peak air particle velocity behind the shock front in cm/sec.

DUMMY	input	Dummy argument
CØMMØN /WFRT/	input	ØPPK, ØDPK
RHØZ	data	Density or air at sea level (1.22E-3 g/cm^3)

SUBRØUTINE WSTUFF (W, SHØB)

This routine defines constants for use throughout the dust cloud routines.

W	input	Burst yield (Mt)
SHØB	input	Scaled height-of-burst (ft/kt$^{1/3}$)
CØMMØN /CØNVR/	input	CVL, CVM, CVT
CØMMØN /THREAT/	input	I
	output	WØLD, SHØLD, HØB, KDUST
CØMMØN /STUFF/	input	TER
	output	PCT, ABO, AFB, AHM, AHT, ARM, BBO, BFB, BHM, BHT, BRM, HMP, HMS, HMO, HTP, HTS, HTO, RBC, RBØ, RBS, RFS, RMS, R2M, TBC, TBØ, TFS, TFW, TF1, TLØ, TPH, T2M
CØMMØN /MASSY/	output	A1, A2, A5, A6, B1, B2, B5, B6, T1, T2, T4, T5, WD1, WD2, WD3, WD4, WD5, WD6
AA1	data	
AA2	data	
AA3	data	
AA4	data	Curve fit constants
AA5	data	
AA6	data	
THIRD	data	One third
EPS	data	Round off epsilon (5×10^{-7})
SH2	data	Maximum SHØB for near surface burst (cratering) mass loading. Above this air burst mass loading used. (20.0)

Routines called: TBREAK

FUNCTIØN XLIM (X, N, I, JM)

This function finds the maximum or minimum value of a one dimensional array.

X	input	Array of values to be searched
N	input	Number of values in X (Maximum of 50)
I	input	Øperation mode flag: $I > 0$ for maximum, $I < 0$ for minimum
JM	output	Location in array X of the extreme value

2.3 COMMON BLOCK DESCRIPTION

As with all computer codes of any size and complexity, NWEM has many common blocks, 45 to be specific. Besides the usual function of transferring information from one routine to another, some common blocks of the NWEM computer code are the connectors with which the executive routine links the separate environmental and exclusion region contour generating routines together, while others serve as connectors which link routines within the separate environmental and contour generating models.

To provide the user with the ability to better use the NWEM computer code, detailed descriptions of the common blocks with respect to their variables are provided on pages following in this section. These descriptions present a brief common block title or usage, the variables in the order they appear in the common block and their dimensional extent if an array, the variable's definition or use and any units or values stored in these variables where appropriate. Certain common blocks will have their variables assume different alphanumeric names in different subroutines. Only one name is presented for each variable in the common block definition; that one most representative. However, all common blocks of this type will agree for variable and array length exactly. No overlay of variables extent exists for different routines.

CØMMØN /BC/ Cone Angle and Parameter Storage for RV Trajectory and Drag Calculation

TCDEG	RV cone angle (deg)
TCRAD	RV cone angle (radian)
SINTC	Sine of the RV cone angle
CØSTC	Cosine of the RV cone angle
TANTC	Tangent of the RV cone angle
RN	RV nose radius (in)
RB	RV base radius (in)
SK	RV surface roughness (in)

CØMMØN /BDAT/ Blast Footprint Data

TB(50)	Time after burst (sec)
BL(50)	Rectangular footprint half-length (kft)
BW(50)	Rectangular footprint half-width (kft)
BC(50)	Downrange position (RV) or uprange position (booster) of rectangular footprint center (kft)
BRMX(50)	Annular footprint maximum radius from burst point (kft)
BRMN(50)	Annular footprint minimum radius from burst point (kft)
PH1(50)	Uprange (RV) or downrange (booster) annular segment internal angle (degrees)
PH2(50)	Downrange (RV) or uprange (booster) annular segment internal angle (degrees)
NR	Number of data points in the rectangular footprint arrays (Maximum of 50)
NC	Number of data points in the annular footprint arrays (Maximum of 50)

CØMMØN /BST/ Booster Launch Exclusion Region Data

FØRADI	Static region radius, centered about ground zero (NMi)
FØTIMS	Time duration of static region - a positive quantity measuring times prior to burst (sec)
BLANG(5,7)	Blast exclusion contour data comprised of 7 sequential time sets of the following quantities expressed in AMM nomenclature: I=1 - BLATIM(7) Blast exclusion region time (negative times go into FØTIMS) (sec) I=2 - BLAØUT(7) Outer radius of the blast annular region (NMi) I=3 - BLAIN(7) Inner radius of the blast annular region (NMi) I=4 - ANGNEA(7) Total annular extent of the near (uprange) blast sector (deg) I=5 - ANGFAR(7) Total annular extent of the far (downrange) blast sector (deg) A circular region is expressed by setting both ANGNEA and ANGFAR equal to 180.
FØTLWC(I,10)	Dynamic exclusion contour data (dust and ejecta/pebble environments) comprised of 10 sequential time sets of the following quantities, expressed in AMM nomenclature: I=1 - FØTIME(10) Dynamic exclusion region time -- only positive times are considered (NMi) I=2 - FØLENT(10) Half-length of the rectangular region (NMi) I=3 - FØWIDT(10) Half-width of the rectangular region (NMi) I=4 - FØCENT(10) Distance from the burst ground zero to the dynamic region center (positive downrange) (NMi)
NBL	Number of blast times containing non-zero data (maximum of 7). Not written on TAPE16
NFØ	Number of dynamic region times containing non-zero data (maximum of 10). Not written on TAPE16

CØMMØN /BURST/	Dust Cloud Parameters
HT	Dust cloud top height (kft)
HM	Dust cloud middle height (kft)
RM	Dust cloud middle radius (kft)
RB	Dust cloud base radius (kft)
RHØ	Dust cloud density (g/cm^3)
HBRV	Second RV burst height or booster launch pt height (kft)

CØMMØN /CØNST/	Constants for Use in Blast Routines
THRD	One third
P1	Atmospheric pressure at sea level ($dynes/cm^2$)
C1	Atmospheric sound speed at sea level (cm/sec)
R1	Atmospheric density at sea level (g/cm^3)
T1	Atmospheric temperature at sea level (°K)

CØMMØN /CØNVR/	Unit Conversion Constants
CVL	Length scale conversion constant (1.0 kft/kft)
CVM	Mass scale conversion constant (1.0 kT/kT)
CVT	Time scale conversion constant (60.0 sec/min)
CVD	Density scale conversion constant (3.2036927×10^{-5} $g/cm^3/kt\text{-}kft^3$)

CØMMØN /DDAT/	Dust and Pebble Footprint Data
TD(50)	Time after burst (sec)
DL(50)	Rectangular footprint half-length (kft)
DW(50)	Rectangular footprint half-width (kft)
DC(50)	Downrange position (RV) or uprange position (booster) of rectangular footprint center (kft)
ND	Number of data points in the rectangular footprint arrays (Maximum of 50)

CØMMØN /DIMEN/	Dust Erosion Calculation Grid Parameters
NY	Number of uprange/downrange positions (100)
NX	Number of crossrange positions (23)
YMAX	Total uprange/downrange length of grid (kft)
DY	Uprange/downrange grid interval size (kft)
DX	Crossrange grid interval size (kft)

CØMMØN /DRAG/	Drag Data Storage
XCN(250)	Normal drag force coefficients corresponding to Mach number values and angle of attack values
XCA(250)	Axial drag force coefficients corresponding to Mach number values and angle of attack values
XA1(10)	Angle of attack values (deg)
XAM(25)	Mach number values
WØA	Weight of RV divided by reference area of RV (lb/ft^2)
NA	Number of angle of attack values
NM	Number of Mach number values

COMMON /DRIDR/ Drag Calculational Flag Storage

ITJF	Trajectory flag indicating that this is a coupled trajectory drag coefficient calculation
XTR	Ratio of turbulent/Laminar transition point along RV body to the RV nose radius
ISTPAS	Flag to initialize variables

COMMON /DTH/ Hollerith Data for Program Output Label

NAME(10) Environment names

1 - NEUT (Neutron fluence)
2 - PGAM (Prompt gamma dose rate)
3 - XRAY (X-ray fluence)
4 - THML (Thermal fluence)
5 - EMP (Peak EMP field strength)
6 - BLST (Peak blast loading (either net or lateral g's)
7 - DUST (Dust
8 - EJCT (Ejecta and pebbles)

LABEL(10) Subroutine names -- stored as two 4 character words per name, left justified

1,2 EMPN
3,4 STATIC
5,6 STATRV
7,8 RADIAT
9,10 PT4
11,12 PT17
15,16 FENV
17,18 MRV3

COMMON /ECONS/ Constants for Ejecta Cloud Dimensions

BBB, HIN, HPK, RIN, RPK, THP, THT, TRP, TRT	Curve fit constants for ejecta cloud dimensions vs. time

CØMMØN /EDAT/	Ejecta Footprint Data
TE(50)	Time after burst (sec)
EL(50)	Rectangular footprint half-length (kft)
EW(50)	Rectangular footprint half-width (kft)
EC(50)	Downrange position (RV) or uprange position (booster) of rectangular footprint center (kft)
NE	Number of data points in the rectangular footprint arrays (Maximum of 50)

CØMMØN /FRAT/	Blast Kill Criteria
FM(6)	Blast kill criteria. Locations 1-3 for booster. Locations 4-6 for RV

CØMMØN /FSPC/	Free Stream Parameter Storage
H2	RV altitude at beginning of time step (ft)
V2	RV velocity at beginning of time step (ft/sec)
P8	Free stream pressure (lbf/ft^2)
T8	Free stream temperature (°R)
A8	Free stream sound speed (ft/sec)
H8	Free stream static enthalpy (BTU/lbm)
HT	Total enthalpy (BTU/lbm)
RHØ8	Free stream density (slug/ft^3)
XMU8	Free stream viscosity (slug/ft-sec)
XM8	Mach number
REFT8	Free stream Reynolds number per foot (ft^{-1})
P8PT8	Free stream pressure ratio variables
Q8	Free stream dynamic pressure (slug/ft-sec^2)

CØMMØN /GPC/ Atmosphere and Physical Constants for Drag Calculation

CP8	Specific heat at constant pressure (0.24 BTU/lbm °R)
G	Conversion factor from slugs to lbm (g_c) (32.174)
GAM8	Free stream ratio of specific heats (γ) (1.4)
XJ	Conversion factor from ft-lbf to BTUs (778.0)
PR	Prandfl number of free stream air (0.71)
RGAS	Air gas constant (R) (1716 ft-lbf/slug-°R)

CØMMØN /HTRAJ/ Vehicle Trajectory in HYDRØ Units

T2(75)	Time array: Time after launch for booster, Time before impact for RV (sec)
R2(75)	Ground range from launch point or impact point (kft)
A2(75)	Altitude of vehicle (kft)
V2(75)	Vehicle velocity (ft/sec)
AN2(75)	Flight path angle from local horizontal (radians)
N2	Number of data points in trajectory arrays (Maximum of 75)

CØMMØN /HTRNS/ Hollerith Data Input and Passed to AMM

LTYPE1	Identifier for Booster or incoming RV
LTYPE2	Identifier for detonating RV
LHØB	Height of burst flag

COMMON /ITRNS/ Integer Input Data

ITYPE	Flight phase flag indicating Booster or RV
NTRJ	Trajectory input flag
NTRJX	Absolute value of trajectory input flag |NTRJ|
NDG1	Number of input Mach numbers and associated drag data for RV trajectory calculation
NDG2	Number of input RV angles of attack and associated drag data for RV trajectory calculation
IMRV	MRV flag
INEUT	Neutron transmission data flag
INET	Absolute value of neutron transmission data flag, |INEUT|
IXRAY	X-ray or Gamma ray transmission data flag
IXM	Absolute value of X-ray or Gamma ray transmission data flag, |IXRAY|

COMMON /LPNC/ Boundary Layer Property Storage

XMEW	Local Mach number at the outer boundary layer edge
REFTN	Local Reynolds number per foot at the outer boundary layer edge (ft^{-1})
RHOEW	Local density at the outer boundary layer edge ($slug/ft^3$)
TEW	Local temperature at outer boundary layer edge (°R)
VEW	Local velocity at the outer boundary layer edge (ft/sec)

COMMON /MASSY/ Case Constants for Dust Cloud Mass Loading Time History

A1, A2, A3, A4, A5, A6, B1, B2, B3, B4, B5, B6, T0, T1, T2, T3, T4, T5, T6, WD1, WD2, WD3, WD4, WD5, WD6	Storage arrays for dust loading curve fit constants. All have four storage locations for four burst cases. Each burst case identified by parameters in COMMON /THREAT/

CØMMØN /ØUT/ Weapon Output and Radiation Transport Data

SX	X-ray source strength for a particular yield and output energy fraction (cal)
TX(60)	X-ray fluence buildup (air mass transmission) factor. Ratio of fluence to exoatmospheric fluence for a particular air mass integral
RTX(60)	Air mass integral values corresponding to the TX array (gm/cm^2)
SN	Neutron source strength for a particular yield and output number (neutrons)
TN(60)	Neutron fluence buildup factor. Ratio of fluence to exoatmospheric fluence for a particular in mass integral
RTN(60)	Air mass integral values corresponding to the TN array (gm/cm^2)
SG	Prompt gamma source strength, expressed as a dose response function, for a particular yield and output energy fraction (rad(Si)-cm^2)
TG(60)	Prompt gamma dose buildup factor. Assumed identical to the energy fluence buildup factor. Ratio of energy fluence to exoatmospheric fluence
RTG(60)	Air mass integral values corresponding to the TG array
ST	Thermal radiation source strength for a particular yield (cal)
NØX	Number of points in the TX and RTX arrays containing data
NØN	Number of points in the TN and RTN arrays containing data
NØG	Number of points in the TG and RTG arrays containing data

CØMMØN /PARAM/

WD	Dust cloud mass loading (kt)

CØMMØN /PTMC/ Constant Storage for RV Trajectory Calculation

PI	π (3.141592653589793)
XRAD	Radians to degrees conversion factor
XMØ	Gravitation constant times the mass of the earth (1.4076452×10^{16} ft^3sec^2)
RØ	Radius of earth (2.0925696×10^7 ft)

CØMMØN /RAD/ Data Transfer for Prompt Radiation

CRIT(10)	Criterion used to define the lethal volume for each environment. These are input data paired through the SUBRØUTINE RADIAT argument list I=1 - Neutron fluence (n/cm^2) I=2 - Peak gamma dose rate (rad(Si)/sec) I=3 - X-ray fluence (cal/cm^2) I=4 - Thermal fluence (cal/cm^2)
WØUT(4)	Weapon source strength expressed in units such that division by an area, $4\pi r^2$, corresponding to a radius, r, yields a quantity which can be directly compared with CRIT
ABURST	Burst altitude, an input quantity passed through the SUBRØUTINE RADIAT argument list (km)
PI	3.14159265
AUPDN	Geometry multiplier for finding lethal volume dimensions (+1. for a calculation above the burst altitude, -1. for one below the burst altitude)
ALAST	Positive angle from horizontal to the maximum radius ray (normal to the trajectory) which terminates at the lethal volume surface point being found (radians)
ISKIP(4)	Flag for each environment, set equal to 1 if the environment is to be skipped for the flight phase being addressed or if a criterion is not input (environment order as for CRIT)
IPHASE	Flight phase index -- defined by data passed from input through the SUBRØUTINE RADIAT argument list 2 - Boost Phase 4 - Reentry Phase

CØMMØN /RAD/ (Con't)

ICHK	Index for determining a reasonable number of iterations to begin converging on the lethal volume size in subroutines PT4 and PT17
IMAX	Index, I, of the time array (T(I), I=1,7) corresponding to the maximum range as calculated in SUBRØUTINE PTMAX so that the proper time index for the final point calculated by SUBRØUTINE PTLAST can be found

CØMMØN /RR1/ Parameters Defining the Radiation Environment Lethal Volume

T(7,4)[a]	Time of flight between lethal volume point (i.e., a hardness plane in the lethal volume) and the earth's surface (sec)
RH(7,4)	Horizontal lethal volume radius at time, T. This is equal to the instantaneous exclusion region radius on the ground (km)
R(7,4)	Radius from burst to lethal volume surface corresponding to time, T (km)
RDEL(7,4)	Horizontal displacement of trajectory between lethal volume point corresponding to T and the surface. This is positive in the downrange direction (km)
RUP(7,4)	Maximum uprange extent of the surface exclusion region corresponding to T, a negative quantity. Measured from burst ground zero (km)
RDN(7,4)	Maximum downrange extent of the surface exclusion region corresponding to T, a positive quantity. Measured from burst ground zero (km)
A(7,4)	Altitude corresponding to Time, T (km)
PERCNT(7,4)	Diagnostic information -- the percentage error in convergence of the environment to the desired environment criterion, CRIT at the lethal volume surface point corresponding to T

(a)Each parameter in this common block is dimensioned up to ITM(I) = ITMAX, a maximum of 7 times and NENV, a maximum of 4 environments. Time index 1 corresponds to the top of the lethal volume.

CØMMØN /RR2/	Extreme Values of Radiation Environment Lethal Volume and Exclusion Region Parameters
TEX(7)[a]	A set of exclusion region times defined to span the total range of times, T, for all radiation environment. Converted to negative times for the boost phase (sec)
RHEX(7)	Maximum horizontal radius, RH, for all radiation environments (km)
REX(7)	Range, R, for environment maximizing RH at each time (km)
RDELEX(7)	Horizontal displacement, RDEL, for environment maximizing RH at each time (km)
RUPEX(7)	Uprange contour extent, RUP, for environment maximizing RH at each time. Measured from burst ground zero (km)
AX(7)	Altitude corresponding to TEX (km)
RDNEX(7)	Downrange contour extent, RDN, for environment maximizing RH at each time. Measured from burst ground zero (km)
TMIN	Minimum value of TEX(I) for the start of the exclusion region (the most negative time in the boost phase) (sec)
TMAX	Maximum value of TEX(I) for the end of the exclusion region (sec)
RHMAX	Maximum value of RHEX(I)
RUPMIN	Minimum value of RUPEX(I)
RDNMAX	Maximum value of RDNEX(I)
NAMEX(7)	Name of radiation environment maximizing RH at each time -- drawn from NAME(I) (hollerith variable)
NAMET1	Radiation environment name corresponding to TMIN (hollerith variable)
NAMET2	Radiation environment name corresponding to TMAX (hollerith variable)
NAMEH	Radiation environment name corresponding to RHMAX (hollerith variable)

CØMMØN /RR2/ (Con't)

NAMEU	Radiation environment name corresponding to RUPMIN (hollerith variable)
NAMED	Radiation environment name corresponding to RDNMAX (hollerith variable)

(a)The number of points calculated is MAXITM (See CØMMØN /RRR/). The first time index corresponds to the top of the lethal volume.

CØMMØN /RRR/ Radiation Exclusion Region Parameters

TIMAX	Maximum time interval, lethal volume to surface for all environments, a positive quantity (sec)
TIMIN	Minimum time interval, a lethal volume to surface for all environments, a positive quantity (sec)
JINDEX	Index of the first radiation environment having valid lethal volume data. Ranges from 1 to 4 with 0 indicating no valid data (environment types are as defined by NAME(I), I=1,4 in CØMMØN /DTH/)
MAXITM	Maximum number of times specified for any of the environments. Ranges from 4 to 7 if any data are valid. If two or more radiation environments are calculated, this redefined as 7 in SUBRØUTINE RADMAX
ILØOPS	The running number of environments for which lethal volumes have been sized. Ranges from 0 to 4
ITM(4)	Number of times calculated for each environment. Ranges from 4 to 7

CØMMØN /RVC/ Reentry Vehicle Targeting Exclusion Region Data

FRSLEN	Half-length of the elliptical static region (NMi)
FRSWID	Half-width of the elliptical static region (NMi)
FRSCEN	Distance from the burst ground zero to the static region center (NMi)
TIMST	Duration of the static region (sec)
TMFLWC(I,10)	Dynamic exclusion contour data (blast, dust, and ejecta/pebble environments) comprised of 10 sequential time sets of the following quantities, expressed in AMM nomenclature: I=1 - TIMDY(10) Dynamic exclusion region time (min) I=2 - FRLENT(10) Half-length of the rectangular region (NMi) I=3 - FRWIDT(10) Half-width of the rectangular region (NMi) I=4 - FRCENT(10) Distance from the burst ground zero to the dynamic region center (NMi)
NTM	Number of dynamic region times containing non-zero data (maximum of 10). Not written on TAPE16

CØMMØN /SØR/ Stored Radiation Transmission Data

XX(2)	Value of X-ray energy fraction
TXI(60,2)	X-ray energy fluence build up factor normalized to exoatmospheric fluence
RTXI(60,2)	Air mass integral corresponding to X-ray energy fluence build up factors (gm/cm^2)
XN(1)	Values of neutron output
TNI(60,1)	Neutron number of fluence build up factor normalized to exoatmospheric fluence
RTNI(60,1)	Air mass integral corresponding to neutron number fluence build up factor (gm/cm^2)
XG(1)	Value of gamma ray energy to dose conversion factor
TGI(60,1)	Prompt gamma ray energy build up factor normalized to the exoatmospheric fluence

CØMMØN /SØR/ (Con't)

RTGI(60,1)	Air mass integral build up factor corresponding to prompt gamma ray energy build up factor (gm/cm^2)
NQX(2)	Number of data points for each stored X-ray transmission data set
NQN(1)	Number of data points for each stored neutron transmission data set
NGN(1)	Number of data points for each stored gamma ray transmission data set
NX	Number of stored X-ray transmission data sets
NN	Number of stored neutron transmission data sets
NG	Number of stored gamma ray transmission data sets

CØMMØN /SPC/ Static Pressure Storage for Drag Calculation

PE	Static pressure at boundary layer edge (lb/ft^2)
PEP8	Static pressure to free stream pressure ratio

CØMMØN /STA/ Extreme Values of the Blast and Radiation Exclusion Region Contours Over All Times

TMN(2)[a]	Static exclusion contour start time; negative for boost, positive for reentry (sec)
TMX(2)	Static exclusion contour ending time; zero for boost, positive for reentry (sec)
RHMX(2)	Maximum instantaneous radius of the surface exclusion region. This is also the maximum cross range contour radius (km)
RUPMIN(2)	Maximum exclusion contour uprange extent (more negative direction) (km)

(a)The first index corresponds to radiation data, the second to blast (since only blast extends to significant negative times with radiation contours for the boost phase). All names with index equal to 2 are "BLST" in SUBRØUTINE STATIC for the boost phase and are not used by SUBRØUTINE STATRV for the reentry phase.

CØMMØN /STA/ (Con't)

RDNMX(2)	Maximum exclusion contour downrange extent (more positive direction) (km)
NMT1(2)	Name of environment corresponding to TMN (hollerith variable)
NMT2(2)	Name of environment corresponding to TMX (hollerith variable)
NMRH(2)	Name of environment corresponding to RHMX (hollerith variable)
NMRU(2)	Name of environment corresponding to RUPMN (hollerith variable)
NMRD(2)	Name of environment corresponding to RDNMAX (hollerith) variable)
IDATA(2)	Flag indicating presence of valid exclusion contour data for environment type I of IDATA is .NE - 0 I=1 - Prompt radiation I=2 - Blast

CØMMØN /STUFF/ Case Constants for Dust Cloud Dimension Time Histories

PCT, ABO, AFB, AHM, AHT, ARF, ARM, BBO, BFB, BHM, BHT, BRF, BRM, HMP, HMS, HMO, HTP, HTS, HTO, RBC, RBØ, RBS, RFS, RF1, RMS, R2M, TBC, TBØ, TBS, TER, TFS, TFW, TF1, TLØ, TPH, TRS, T2M	Storage arrays for cloud dimension curve fit constants. All have four storage locations for four burst cases. Each burst case identified by parameters in CØMMØN /THREAT/
RFB	Fireball radius as defined in EARLY (kft)

CØMMØN /THER/ Default Values for Input Quantities

THER1	Thermal transmission default value
DUSTFL	Dust cut-off time default value (25 min)

CØMMØN /THREAT/ Identifiers for Burst Conditions Which Already Have Constants Stored

I	Index of current case
N	Number of conditions stored (Maximum of 4)
WØLD(4)	Burst yield array (Mt)
SHØLD(4)	Scaled height of burst array (ft/kt$^{1/3}$)
HØB(4)	Height of burst array (kft)
KDUST(4)	Dust cloud flag: 0 - no dust cloud 1 - normal dust cloud

CØMMØN /TRAJ/ Vehicle Trajectory Data Storage

TI(75)	Time array Booster - time after launch (sec) RV - time before impact (sec)
R1(75)	Ground range from launch point or to impact point (NMi)
AL1(75)	Altitude (ft)
V1(75)	Velocity (ft/sec)
A1(75)	Flight path angle with respect to local horizontal (deg)
NTRAJ	Number of data points in trajectory arrays (75 maximum)

CØMMØN /TRAJX/ Stored Booster Trajectory Data

QT2(75,1)	Trajectory time data (sec)
QR2(75,1)	Trajectory range data (nmi)
QAL2(75,1)	Trajectory altitude data (ft)
QV2(75,1)	Trajectory velocity data (ft/sec)
QA2(75,1)	Trajectory booster angle data (deg)
NT(1)	Number of data points for each stored trajectory
NTM	Number of stored trajectories

CØMMØN /TRNS/ Input Data Storage

BLST1 — Blast vulnerability criteria data
- Booster - free field overpressure (psi)
- RV - total acceleration (g's)

BLST2 — Blast vulnerability criteria data
- Booster - ratio of overpressure to ambient pressure
- RV - axial aceleration (g's)

BLST3 — Blast vulnerability criteria data
- Booster - dynamic pressure times angle of attack (psi-deg)
- RV - normal acceleration (g's)

DUST1 — Dust vulnerability criteria, intercepted kinetic energy (kJ/cm^2)

DUST2 — Dust vulnerability criteria, cloud cutoff time (min)

DUST3 — Cloud cutoff time used for calculation (min)

PEBB1 — Pebble/ejecta vulnerability criteria, critical particle diameter (cm)

PEBB2 — Pebble/ejecta vulnerability criteria, critical hit density ($\#/cm^2$)

THER1 — Thermal vulnerability criteria, thermal fluence (cal/cm^2)

THERF — Fluence multiplication factor for transmission correction

XNEUT1 — Neutron vulnerability criteria, neutron fluence (n/cm^2)

XGM1 — X-ray/gamma ray vulnerability criteria
- Booster - X-ray energy fluence (cal/cm^2
- RV - Peak gamma ray dose rate (rad(Si)/sec)

EMP1 — EMP vulnerability criteria, peak EMP field strength (V/m)

RVHT — RV initial reentry altitude (ft)

RVANG — RV initial reentry angle (deg)

RVVEL — RV initial reentry velocity (ft/sec)

RVMAS — RV mass (slugs)

RVARA — RV reference (base) area (ft^2)

CØMMØN /TRNS/ (Con't)

RVNR	RV nose radius (in)
RVBR	RV base radius (in)
RVCHA	RV cone half angle (deg)
RVSR	RV surface roughness (in)
RVCYHA	RV cylinder half angle (deg)
RVFHA	RV flare half angle (deg)
RVCL	RV cone length along axis (in)
RVCYC	RV cylinder length along axis (in)
RVFL	RF flare length along axis (in)
YLD	Warhead yield of detonating RV (kt)
YHØB2	Burst altitude of detonating RV
XNEUTX	Neutron output (n/kt)
XFRAC	X-ray/gamma ray energy fraction
GAMDS	Gamma ray energy to dose conversion factor (rad(Si)cm^2/cal)
GAMPL	Gamma ray pulse width (nsec)
RADMAX	MRV pattern radius (NMi)
RADTIM	Time between bursts (sec)
XTM1	Gamma ray vulnerability criteria used, peak gamma ray dose rate (rad(Si)/sec)
XTM2	X-ray vulnerability criteria used, x-ray energy fluence (cal/cm^2)
TIMX(75)	Booster trajectory data, time after launch (sec)
ALT(75)	Booster trajectory data, altitude (ft)
RNG(75)	Booster trajectory data, ground range (NMi)
VEL(75)	Booster trajectory data, velocity (ft/sec)
ANG(75)	Booster trajectory data, flight path angle above the horizon (deg)

CØMMØN /TRNS/ (Con't)

AMX(25)	Mach number values for drag data
ANGX(10)	Angle of attack values for drag data (deg)
CN(250)	Normal drag force coefficients corresponding to the Mach number values and angle of attack values
CA(250)	Axial drag force coefficient corresponding to the Mach number values and angle of attack values
RHØRN(60)	Air mass integral values for neutron transmission data (g/cm^2)
XNETX(60)	Normalized neutron transmission values as a function of air mass integral
RHØRX(60)	Air mass integral values for X-ray/gamma ray transmission data (g/cm^2)
XPHI(60)	Normalized X-ray/gamma ray transmission values as a function of air mass integral

CØMMØN /TRNSC/ Drag Coefficient Parameter Storage

LAMINR	Laminar flow flag (0/1 - laminar/turbulent or mixed)
RNRTR	Ratio of the RV nose radius to the laminar turbulence transition point
XKTR	Transition point parameter

CØMMØN /TRNSL/ Storage Limits for Input Quantities

NDG1M	Storage limit for Mach numbers and associated drag data for RV trajectory
NDG2M	Storage limit for RV angles of attack and associated drag data for RV trajectory
NTRJXM	Storage limit for booster trajectory data
INETM	Storage limit for neutron transmission data
IXTRM	Storage limit for X-ray or gamma ray transmission data

CØMMØN /VOLLY/

V	Dust cloud volume (kft^3)

CØMMØN /WFRT/	Air Blast Waveform Parameters for 1 Kt Free Air Burst at Sea Level
PRAD	Shock radius (cm)
ØPPK	Peak overpressure at PRAD ($dynes/cm^2$)
ØDPK	Peak overdensity at PRAD (g/cm^3)
VPK	Peak air velocity at PRAD (cm/sec)
ØPR	Overpressure ($dynes/cm^2$)
ØDR	Overdensity (g/cm^3)
VR	Air velocity (cm/sec)
RZP	Range to end of overpressure positive phase (cm)
RZD	Range to end of overdensity positive phase (cm)
RZV	Range to end of air velocity positive phase (cm)
ØPMN	Minimum overpressure ($dynes/cm^2$)
ØDMN	Minimum overdensity (g/cm^3)
VMN	Minimum air velocity (cm/sec)

CØMMØN /WPN/	Weapon Radiation Data
W	Burst yield (kt)
FN	Neutron output source strength; set equal to 2.41 E+23 if not input (neutrons/kt)
FG	Gamma output energy fraction; set equal to 0.003 in the unclassified version of NWEM if not input. See Section 3.4 of Volume I for a discussion of the proper value for specific warheads
FX	X-ray output energy fraction; set equal to 0.75 if not input
FT	Thermal output energy fraction for low altitude bursts. Defined by a yield-dependent functional relationship if not input
DELTG	Effective prompt gamma fall-width, half-maximum (FWHM) pulsewidth. Set equal to 20. if not input See section 3.5 of Volume I for a discussion of the proper value for specific warheads (nsec). Conversion factor from gamma energy fluence to silicon dose, valid at the anticipated range (air mass integral) for the prompt gamma dose rate lethal volume surface; set equal to 1.4 E+03 if not input (rad(Si)/(cal/cm^2)
TFACT	Factor by which the thermal radiation environment is multiplied to account for atmospheric transport and cloud/earth surface albedo

COMMON /XTITL/	Output Flag and Problem Title Storage
LEVØUT	Flag indicating level of output 0 - File 16 AMM exclusion contour region data 1 - In addition to above, input and AMM exclusion contour region data output 2 - In addition to above an expansion of input data results and exclusion contour region data by environment 3 - In addition to above, program diagnostic/debug data output
TITLE(13)	Storage for problem title

2.4 BLOCK DATA DESCRIPTION

The block data that is in the present version of the NWEM computer code is composed of two types of variables. This division of the variables into two groups results from their use or function. The two uses of the variables are for environment model and program functional data and for prestored input related data. Those variables defined as environment model variables are those variables which are associated with the model descriptions which predict the environments. Those variables defined as program functional variables are those variables associated with the program, such as storage limitations and output labels. Those variables defined as prestored input related variables are used to store data that would otherwise be read as input from the input file (5). The necessity for those data used for the environment models and program functional data is evident. Those data are contained in the commons /TRNSL/, /THER/, /DTH/, /CØNVR/, /THREAT/, /MASSY/, and /STUFF/ and are defined in their respective common definitions in the previous section on common blocks.

The use of block data for prestored input related data is not as evident. At the time the NWEM computer code was being designed, it was thought that for code check-out the most straight forward method of handling input related data would be using block data. By prestoring that part of the input data such as radiation transmission data and booster trajectory, the amount of input required was reduced and problem input facilitated, making check-out of the code easier. To a limit, this technique of prestored input related data can be extended to include more and more data sets; however, a limit does exist (See section 3.1).

The prestored input related data consists of two types, radiation transmission data and booster trajectory data. In the NWEM computer code, the nuclear radiation environments are modeled using "build-up factors", air transmission factors which are the value of the air transported environment normalized to the space environment value. (See section 3.4 of Volume I). The ANISN discrete ordinates code has been used to determine air transmission functions for representative neutron, X-ray and peak prompt gamma doses. These data; a representative neutron transmission set, two representative X-ray transmission sets and one representative

uncollided prompt gamma set; are stored in the variables of common /SØR/. (See previous section). Since booster trajectories are not calculated in NWEM and are required, they must be supplied. One representative trajectory is stored in common /TRAJX/ (See previous section).

2.5 INPUT GUIDE

Input to the NWEM computer code is read from the normal input file (5) and, at present, no other input files are required. The input data has been grouped into two major sets, those parameters associated with the vehicle (booster or RV) characteristics necessary to define the exclusion region criteria and those parameters associated with the detonating RV to define the environments resulting from the nuclear explosion. Within each major group, the input has also been grouped to keep parameters of like kind together.

For the booster flyout exclusion region contours, three sets of data are needed. The first data set is the booster and problem identification and flags. While booster identification is not needed by NWEM for calculational purposes it is required for output to the AMM output file (16). The second set of data is the vulnerability criteria data. For the booster these criteria are blast, dust, pebble/ejecta, thermal, neutron, x-ray and high altitude EMP. The third set of data is the booster trajectory data. In the present version of the code the booster trajectory can also be specified as being one prestored in the block data.

For the RV fratricide exclusion region contours, again three sets of data are needed. The first data is the RV and problem identification and flags. As with the booster, the RV identification is for output to the AMM output file (16). The second set is the vulnerability criteria data which for RVs are blast, dust, pebble/ejecta, neutron and gamma ray. The third set of data is the vehicle parameters to compute the RV trajectory. This set of data can take two forms. One form is the input of drag force coefficients arrays to be used for both the trajectory calculation and the RV blast vulnerability calculation. The other form is the input of additional RV geometry to be used to calculate the drag force coefficients array to be used for both the trajectory calculation and the RV blast vulnerability calculation.

The parameters associated with the detonating RV are grouped into two sets, the RV identifiers and flags and the weapon characteristics including the air transport of the radiation. Again, there are some RV identifiers

which are only needed for output to the AMM output file. And in the present version the air transports for the radiation environments can be specified as being prestored in block data.

Because AMM treats MRVs in a coupled fashion (see Volume I), there are data required as part of the RV identifiers specifying MRV type. In the case of the MRV type in which the RVs are in-line and having different weapon yields, characteristics or burst altitudes, the weapon characteristics cards have to be input for a second pass of the code to get the second exclusion region contours. (At present this option of MRV is not implemented).

Besides grouping the data consistently, the field structure of the cards has been formatted to facilitate user handling of the input. All formats are arranged for fields to be 5 or 10 characters only. No other increments are used.

On the following pages of this section the input to the code is given and explained for each card in detail. Restrictions, defaults and other requirements have been included to make this input self explanatory. Additionally, the user is directed to the sample problems for further explanation.

Card 1 Problem Identification and Flags

Format I5, A4, 1X, I5, 4X, A1, 13A4

ITYPE Flight phase flag
Booster - 2
RV - 4

LTYPE1 Vehicle identifier

NTRJ Trajectory input flag
Booster - NTRJ $\geq$ 0, use prestored trajectory set number
NTRJ > 0, input/NTRJ/ trajectory data card sets as Card 16
RV - NTRJ $\geq$ 0, calculate drag data
- NTRJ < 0, input drag data as Cards 10 through 14

LEVØUT Output option flag
0 - Only AMM exclusion region data are output on AMM output file (16)
1 - In addition to above, input is echoed and AMM exclusion region data are output to normal output file (6)
2 - In addition to above, the input echo is expanded and exclusion regions by environment are output on normal output file
3 - In addition to above, more detailed exclusion region data are output on normal output file

Error and program messages are always output on normal output file

TITLE Problem title

Card 2 Blast Vulnerability Criteria Data

Format 3E10.0

BLST1 Booster - Free field overpressure (psi)
RV - Total acceleration (g's)

BLST2 Booster - Ratio of overpressure to ambient pressure
RV - Axial acceleration (g's)

BLST3 Booster - Dynamic pressure times angle attack (psf-deg)
RV - Normal acceleration (g's)

If all 3 values are 0., no blast exclusion region contour will be calculated. A composite contour is calculated for combinations of the criteria.

Card 3 Dust Vulnerability Criteria

Format 2E10.0

DUST1 Intercepted kinetic energy (kJ/cm^2)

DUST2 Cloud cut-off time (min)

If both values are 0, no dust exclusion region contour will be calculated. If DUST1=0. and DUST2≠0., cloud avoidance will be used. For DUST2 < 0. or for DUST2=0. and DUST1 > 0., the default (25 min) will be used for cloud cut-off time.

Card 4 Pebble/Ejecta Vulnerability Criteria

Format 2E10.0

PEBB1 Critical particle diameter (cm)

PEBB2 Critical hit density ($\#/cm^2$)

If both values are 0., no pebble/ejecta exclusion region contours are calculated. If either is not 0., the code presently only does cloud avoidance to a predetermined cut-off time.

Card 5 Thermal Vulnerability Criteria
(Enter only if ITYPE = 2, Booster)

Format 2E10.0

THER1 Thermal fluence (cal/cm^2)

THERF Fluence multiplication factor for transmission corrections (defaults to 1.0)

If THER1=0., no thermal exclusion region contour will be calculated.

Card 6 Neutron Vulnerability Criteria

Format E10.0

XNEUT1 Neutron Fluence (n/cm^2)

If XNEUT1=0., no neutron exclusion region contour will be calculated.

Card 7 X-ray/Gamma Ray Vulnerability Criteria

Format E10.0

XMG1 Booster - X-ray fluence (cal/cm^2)
RV - Peak gamma ray dose rate (rad(Si)/sec)

If XMG1=0., no X-ray/gamma ray exclusion region contour will be calculated.

Card 8 EMP Vulnerability Criteria
(Enter only if ITYPE=2, booster)

Format E10.0

EMP1 Peak EMP field strength (V/m)

If EMP1=0., no exclusion region contour will be calculated

Card 9 Reentry Vehicle Parameters
(Enter only if ITYPE=4, RV)

Format 5E10.0

RVHT Reentry altitude (ft)
(If RVAT=0., the default, 300000. ft, will be used)

RVANG Reentry angle at altitude RVHT (deg)

RVVEL Reentry velocity at altitude RVHT (ft/sec)

RVMAS Vehicle mass (slug)

RVARA Vehicle reference (base) area (ft^2)

Card 10 Drag Data Array Parameters
(Enter only if ITYPE=4, RV, and NTRJ < 0)

Format 2I5

NDG1 Number of Mach Number values input on card data sets as Card 11 (Maximum of 25)

NDG2 Number of angles of attack input on card data sets as Card 12 (Maximum of 10)

Card 11 Mach Numbers for Drag Coefficients
(Enter only if ITYPE=4, RV, and NTRJ < 0)

Format 7E10.0

AMX Mach number values in increasing magnitude (Enter NDG1 values to maximum of 25)

Card 12 Angles of Attack for Drag Coefficients
(Enter only if ITYPE=4, RV, and NTRJ < 0)

Format 7E10.0

ANGX Angle of attack values in increasing magnitude. The first value must be 0.
(Enter NDG2 values to maximum of 10)

Card 13 Normal Drag Force Coefficients
(Enter only ITYPE=4, RV, and NTRJ < 0)

Format 7E10.0

CN Normal drag force coefficients. Enter NDG2 data sets corresponding to the angles of attack. Each data sets contains NDG1 values corresponding to the Mach numbers. (Total number of values, NDG1xNDG2, maximum in number of values, 25x10)

Card 14 Axial Drag Force Coefficients
(Enter only if ITYPE=4, RV, and NTRJ < 0)

Format 7E10.0

CA Axial drag force coefficients. Enter NDG2 data sets corresponding to the angles of attack. Each data sets contains NDG1 values corresponding to the Mach numbers. (Total number of values, NDG1xNDG2, maximum number of values, 25x10)

Card 15 Reentry Vehicle Geometry
(Enter only if ITYPE=4, RV, and NTRJ ≥ 0)

Format 7E10.0

RVNR Nose radius (in)

RVBR Base radius (in)

RCVHA Cone half angle (deg)

RVSR Surface roughness (in)
(If RVSR=0., the default, 0.02 in, is used)

RVCYHA Cylinder half angle (deg)

RVFHA Flare half angle (deg)

RVCL Cone length along axis (in)

RVFL Flare length along axis (in)

RVCYHA, RVFHA, RVCL, RVCYL, and RVFL are not presently operational in this version of the code, but blank fields at least are required in the input stream.

Card 16 Booster Trajectory Data
(Enter only if ITYPE=2, booster, and NTRJ < 0)

Format 5E10.0

TIMX Time after launch (sec)

ALT Altitude (ft)

RNG Ground range (NMi)

VEL Velocity (ft/sec)

ANG Flight path angle to the local horizon (deg)

Enter |NTRJ| card data sets (Maximum of 75)

Card 17 Detonating RV Identifiers and Flags

Format A4, 1X, A1, 4X, I5

LTYPE2 Detonating RV (RVs) identifiers

LHØB Height of burst flag

IMRV MRV flag
- 0 - Single RV
- 1 - Circular pattern of 3 or more RVs
- 2 - Two in-line RVs
- 3 - Two in-line RVs of different yield. The uprange burst can have a different yield, weapon characteristics, burst altitude and be at a later time. (This option is not presently implemented)

Card 18 MRV Parameters
(Enter only if IMRV≠0)

Format 2E10.0

RADMAX MRV pattern radius. Half the ground range distance between bursts for IMRV=2 or 3. (NMi)

RADTIM Time between bursts (sec) (Enter only if IMRV=3)

Card 19 Detonating RV Burst Altitude

Format E10.0

XHØB2 Burst altitude for RV (ft)

Card 20 Warhead Data for Booster Exclusion Region Calculations
(Enter only if ITYPE=2, Booster)

Format 2E10.0, I5, E10.0, I5

YLD Warhead yield (kT)

XNEUTX Neutron output (n/kt)

INEUT Neutron transmission flag

For INEUT > 0, use prestored neutron transmission data set number IXRAY and if XNEUTX=0. use corresponding prestored neutron output. For INEUT < 0, input neutron transmission data using Cards 22 and 23 XNEUTX must be input.

XFRAC X-ray energy fraction

IXRAY X-ray transmission flag

For IXRAY > 0 use prestored X-ray transmission data set number IXRAY and if XFRAC=0. use corresponding prestored x-ray energy fraction. For IXRAY < 0 input x-ray transmission data using Cards 24 and 25 and XFRAC must be input.

Card 21 Warhead Data for RV exclusion Region Calculations
(Enter only if ITYPE=4, RV)

Format 2E10.0, I5, E10.0, I5, 2E10.0

YLD Warhead yield (kt)

XNEUTX Neutron output (n/kt)

INEUT Neutron transmission flag

For INEUT > 0 use prestored neutron transmission data set number INEUT and if XNEUTX=0. use corresponding prestored neutron output. For INEUT < 0, input neutron transmission data using Cards 26 and 27 INEUTX must be input.

XGAM Gamma ray energy fraction

IGAM Gamma ray transmission flag

GAMPL Gamma ray pulse width
(If GAMPL=0., code calculated value is used)

GAMDS Gamma ray energy fluence to dose conversion factor
(rad(Si)-cm^2/cal)

For IGAM > 0 use prestored gamma ray transmission data set IGAM and if GAMDS=0. use corresponding prestored gamma ray energy to dose conversion factor. For IGAM < 0, input gamma ray transmission data using Cards 26 and 27 GAMPL must be input.

Card 22 Neutron Transmission Data
(Enter only if INEUT < 0)

Format 7E10.0

RHØRN Air mass integral values for neutron transmission data in increasing magnitude. Enter |INEUT| values (maximum of 60) and first value must be C. (gm/cm^2)

Card 23 Neutron Transmission Data
(Enter only if INEUT < 0)

Format 7E10.0

XNETX Normalized neutron transmission values corresponding to the air mass integral. Enter |INEUT| values (maximum of 60)

Card 24 X-ray Transmission Data
(Enter only if IXRAY < 0)

Format 7E10.0

RHØRX Air mass integral values for x-ray transmission data in increasing magnitude. Enter |IXRAY| values (maximum of 60) and first value must be 0. (gm/cm^2)

Card 25 X-ray Transmission Data
(Enter only if IXRAY < 0)

Format 7E10.0

IPHI Normalized x-ray transmission values corresponding to the air mass integral. Enter |IXRAY| values (maximum of 60)

Card 26 Gamma Ray Transmission Data
(Enter only if IGAM < 0)

Format 7E10.0

RHØRG Air mass integral values for gamma ray transmission data in increasing magnitude. Enter |IGAM| values (maximum of 60) and first value must be 0. (gm/cm^2)

Card 27 Gamma Ray Transmission Data
(Enter only if IGAM < 0)

Format 7E10.0

Normalized gamma ray transmission values corresponding to the air mass integral. Enter /IGAM/ values (maximum of 60)

For IMRV=3 Card 19 and Card 20 (booster, ITYPE=2) or Card 21 (RV,ITYPE=4) are input and Cards 22 through 27 are input as necessary. Three addition conditions for this pass through these cards exist. (This option is not currently implemented).

For XNEUTX=0. and INEUT=0., the neutron transmission data and output are the same as for the first RV.

For XFRAC=0. and IXRAY=0, the x-ray transmission data and energy fraction are the same as for the first RV.

For GAMDS and IGAM=0, the gamma ray transmission data and energy to dose conversion factor are the same as for the first RV.

2.6 OUTPUT DESCRIPTION

The output of the NWEM computer code has been structured to allow the user to select the output for his application or need for detail. By allowing this flexibility, the NWEM code can be used for system studies other than just as an exclusion region contour generator for AMM. However, because NWEM was developed to generate exclusion region contour data for AMM, the output will obviously reflect this aspect of the NWEM code.

The amount of output the user chooses is controlled by the input variable, LEVØUT, on Input Card 1. This choice of output amount or level ranges from selecting only the final AMM output on the AMM output file (16) to selecting detailed input echoing and detailed exclusion region contour data by environment. In particular, there are four levels of output. The first level, LEVØUT = 0, is only that data for the final AMM exclusion region contours output on file 16 only. The second level, LEVØUT = 1, is the additional output on the output file (6) of a minimum of input echoing, and output of the final AMM exclusion region contours. The third level, LEVØUT = 2, of output increases the amount of data output to the output file (6) by increasing the input echoing to include information implied by the input such as prestored data and data calculated by the RV trajectory routines and by adding the AMM exclusion region contour data by environment. The fourth level, LEVØUT = 3, adds the output of detailed exclusion region contour data for several environments. For all levels of output, error messages and other significant program messages are always output on the output file (6).

As stated, the objective of the NWEM computer code is to generate AMM exclusion region contours for boosters and RVs and as indicated, this information is always output on output file 16. This data has required parameter orders and a set number of parameters for booth boosters and RVs to describe the exclusion regions treated by AMM. These regions are described in detail in Volume I but are iterated here for clarity. The exclusion region contours for the booster are a static circular region, a dynamic segmented annular or circular "blast" region and a dynamic rectangular region. For the RV exclusion region contours, they are a static elliptical region and a dynamic rectangular region. A listing of these parameters,

their order and their computer types are given on the following pages. This list also corresponds to the computer variables of file 16 listed at the end of each sample problem. For additional information the user is referred to the common definitions for commons /BST/ and /RVC/.

Because the output to the normal output file (6) is self explanatory and because the sample problems have been additionally annotated, the user is referred to the sample problems for explanation of the output to this file.

AMM Exclusion Region Contour Parameters and Parameter Order for Booster Flyout Data

Parameter	Type
Identification of booster type	hollerith
Identification of detonating RV type	hollerith
Height of burst option for RV	hollerith
Radius of static region (NMi)	real
Time duration of static region (sec)	real
First time for blast exclusion region (sec)	real
Outer radius of blast exclusion region at first time (NMi)	real
Inner radius of blast exclusion region at first time (NMi)	real
Angle for near sector of blast exclusion region at first time (deg)	real
Angle for near sector of blast exclusion region at first time (deg)	real
•	•
•	•
•	•
Seventh time for blast exclusion region (sec)	real
Outer radius of blast exclusion region at seventh time (NMi)	real
Inner radius of blast exclusion region at seventh time (NMi)	real
Angle for near sector of blast exclusion region at seventh time (deg)	real
Angle for near sector of blast exclusion region at seventh time (deg)	real
First time of dynamic region (min)	real
Downrange dimension of dynamic region at first time (NMi)	real
Cross range dimension of dynamic region at first time (NMi)	real
Distance from burst to center of the dynamic region at first time (NMi)	real
•	•
•	•
•	•
Tenth time of dynamic region (min)	real
Downrange dimension of dynamic region at tenth time (NMi)	real
Cross range dimension of dynamic region at tenth time (NMi)	real
Distance from burst to center of the dynamic region at tenth time (NMi)	real

AMM Exclusion Region Contour Parameters and Parameter Order for RV Fratricide Data

Parameter	Type
Identification of incoming RV type	hollerith
Identification of detonating RV type	hollerith
Height of burst option for detonating RV	hollerith
Reentry angle option of incoming RV (deg)	real
Downrange dimension of static region (NMi)	real
Cross range dimension of static region (NMi)	real
Uprange dimension of static region (NMi)	real
Time duration of static region (sec)	real
First time of dynamic region (min)	real
Half-length dimension of dynamic region at first time (NMi)	real
Half-width dimension of dynamic region at first time (NMi)	real
Distance from burst to center of dynamic region at first time (NMi)	real
•	•
•	•
•	•
Tenth time of dynamic region (min)	real
Half-length dimension of dynamic region at tenth time (NMi)	real
Half-width dimension of dynamic region at tenth time (NMi)	real
Distance from burst to center of dynamic region at tenth time (NMi)	real

2.7 SAMPLE PROBLEMS

Two sample problems demonstrating the capabilities of the NWEM computer code are presented in this section. These problems are generally representative of boosters and RVs and do not represent any particular system

The first sample problem is a booster flyout exclusion problem. Input Card 1 indicates that this problem is a booster identified as BST1, prestored trajectory data set 1 is used, all output levels are printed and the problem title is BOOSTER ALL LOW ALTITUDE ENVIRONMENTS. Input Cards 2 through 8 indicate a 1.0 psi free field overpressure is the only blast criteria, the 25 min. cloud cut-off time is used for 0.3 kJ/cm^2 intercepted kinetic energy dust criteria, cloud avoidance for pebble/ejecta is in effect, a 1.0 cal/cm^2 thermal fluence, thermal criteria, is used with the 1.0 default thermal transmission factor, 1.0x10^{12} n/cm^2 neutron fluence is the neutron criteria, a 0.1 cal/cm^2 x-ray fluence is the x-ray criteria and EMP is not considered. Input card 17 indicates that the detonating RV is identified as RV A with a height of burst option of A,and it is not an MRV problem. Card 19 indicates a burst altitude of 100. ft. and Card 20 indicates that the yield is 1000. kt, that the prestored neutron transmission data set 1 and its respective neutron output are used, and that the prestored x-ray transmission data set 2 and its respective x-ray energy fraction are used.

The second sample problem is an RV fratricide exclusion problem. Input Card 1 indicates that this is an RV identified as RV B, that the drag data are calculated as well as the trajectory, all output levels are printed and the problem title is ALL REENTRY ENVIRONMENTS. Input Cards 2 through 4 indicate that a 250. G total acceleration is the only blast criteria, that the 25 min. default cloud cut-off time is used for the 1.0 kJ/cm^2 intercepted kinetic energy dust criteria and that cloud avoidance for pebble/ejecta is in effect. Card 6 indicates a 1.0x10^{12} n/cm^2 neutron fluence is the neutron criteria and Card 7 indicates a peak gamma ray dose rate of 1.0x10^7 rad(Si)/sec is the gamma ray criteria. Card 9 indicates that the initial reentry altitude is 300000. ft, initial reentry angle is 24°, initial reentry velocity is 24000. ft/sec, the RV mass is

22.9 slugs and the RV reference area is 5.15 ft^2. Card 15 indicates that the RV nose radius is 3.84 in., the RV base radius is 15.37 in., the RV cone half angle is 7.5°, the 0.02 in. default surface roughness is used and the other variables ignored but necessary as explained by the input guide. Input Card 17 indicates that the detonating RV is identified as RV A with a height of burst option of S and it is not an MRV problem. Card 19 indicates a burst altitude of sea level and Card 20 indicates that the yield is 1000. kt, that prestored neutron transmission set 1 and its respective neutron output are used and that prestored gamma ray transmission data set 1 with its respective gamma ray energy to dose conversion factor are used with the gamma ray energy fraction and pulse width calculated by NWEM.

From the expanded output for these cases, it is verified that the inputs to the problems have been entered and stored appropriately. In addition, the selected prestored trajectory data, neutron transmission data and x-ray transmission data are listed and can be verified for the booster problem (sample problem 1), and the calculated drag coefficients, calculated RV trajectory data, prestored neutron transmission data and gamma ray transmission data are listed and can be verified for the RV problem (sample problem 2). The next output set is the mechanical environment data consisting of the detailed blast exclusion region data by time increments, followed by the reduced (AMM region type) blast exclusion region data, the reduced ejecta exclusion region data and the combined reduced pebble/dust exclusion region data. Following the mechanical environment output is the output of the radiation environments data, consisting of detailed radiation environment data followed by the reduced radiation exclusion region data. Following the radiation environment data is the printed output of the final AMM exclusion region data which agrees with the data output to the AMM exclusion region output file (16).

To facilitate user understanding of the output, the output listings of the sample problems have been annotated to reflect their level and definition.

Input for Sample Problem 1 - Booster Flyout Exclusion Problem

```
  2BST1     1    3BOOSTER ALL LOW ALTIUTDE ENVIRONMENTS                 CARD 1
     1.         0.        0.                                           CARD 2
    0.3         0.                                                     CARD 3
     1.         0.                                                     CARD 4
    10.         0.                                                     CARD 5
1.E+12                                                                 CARD 6
    0.1                                                                CARD 7
     0.                                                                CARD 8
RV A A      0                                                          CARD17
   100.                                                                CARD19
  1000.         0.    1        0.    2                                 CARD20
```

Booster Flyout Exclusion Problem Output

```
—————————————————————— Output Level 1 - Input Echo:  Booster and Problem Identifiers —
BOOSTER ALL LOW ALTIUTDE ENVIRONMENTS
THIS IS A BOOSTER FOOTPRINT FOR BOOSTER BST1

—————————————————————— Output Level 1 - Input Echo:  Vulnerability Criteria  ————
BLAST VULNERABILITY CRITERIA DATA
    FREE FIELD OVERPRESSURE                1.00000E+00 PSI
    OVERPRESSURE RATIO                     0.
    DYNAMIC PRESSURE TIMES ANGLE OF ATTACK 0.          PSI-DEG

DUST VULNERABILITY CRITERIA DATA
    INTERCEPTED KINETIC ENERGY    3.00000E-01 KJ/CM**2
    CLOUD CUT-OFF TIME INPUT      0.          MIN
    CLOUD CUT-OFF TIME USED       2.50000E+01 MIN

PEBBLE/EJECTA VULNERABILTY CRITERIA DATA
    CRITICAL PARTICLE DIAMETER    1.00000E+00 CM
    CRITICAL HIT DENSITY          0.          NO/CM**2
*** REGARDLESS OF INPUT ONLY AVOIDANCE WILL BE USED ***

THERMAL VULNERABILITY CRITERIA DATA
    THERMAL FLUENCE              1.00000E+01 CAL/CM**2
    TRANSMISSION FACTOR INPUT    0.
    TRANSMISSION FACTOR USED     1.00000E+00

NEUTRON VULNERABILITY CRITERIA DATA
    NEUTRON FLUENCE    1.00000E+12 N/CM**2

X-RAY VULNERABILITY CRITERIA DATA
    X-RAY FLUENCE    1.00000E-01 CAL/CM**2

EMP VULNERABILITY CRITERIA DATA
    FIELD STRENGTH    0.          V/M

—————————————————————— Output Level 1 - Input Echo:  Booster Trajectory  ————
STORED TRAJECTORY DATA USED
    SET NUMBER      1
```

62 TRAJECTORY POINTS

TIME SEC	ALTITUDE FT	RANGE NMI	VELOCITY FT/SEC	ANGLE DEG
0.	0.	0.	8.00000E+01	8.99830E+01
4.00000E+00	7.00000E+02	1.00000E-03	2.71900E+02	8.99830E+01
6.00000E+00	1.30000E+03	3.30000E-02	3.74900E+02	8.28669E+01
8.00000E+00	2.10000E+03	6.60000E-02	4.82300E+02	7.87817E+01
1.00000E+01	3.20000E+03	1.32000E-01	5.94300E+02	7.58653E+01
1.20000E+01	4.40000E+03	2.14000E-01	7.11100E+02	7.35391E+01
1.40000E+01	5.80000E+03	3.12000E-01	8.33100E+02	7.15452E+01
1.60000E+01	7.40000E+03	4.44000E-01	9.60000E+02	6.97863E+01
1.80000E+01	9.20000E+03	6.09000E-01	1.09130E+03	6.81877E+01
2.00000E+01	1.12000E+04	7.89000E-01	1.22530E+03	6.67209E+01
2.20000E+01	1.34000E+04	1.02000E+00	1.36300E+03	6.53573E+01
2.40000E+01	1.58000E+04	1.26600E+00	1.50630E+03	6.40796E+01
2.60000E+01	1.85000E+04	1.56200E+00	1.65580E+03	6.28764E+01
2.80000E+01	2.13000E+04	1.89100E+00	1.81170E+03	6.17362E+01
3.00000E+01	2.44000E+04	2.25300E+00	1.97470E+03	6.06590E+01
3.20000E+01	2.76000E+04	2.66400E+00	2.14530E+03	5.96277E+01
3.40000E+01	3.11000E+04	3.12500E+00	2.32390E+03	5.86422E+01
3.60000E+01	3.49000E+04	3.63500E+00	2.51130E+03	5.76969E+01
3.80000E+01	3.88000E+04	4.19400E+00	2.70810E+03	5.67973E+01
4.00000E+01	4.31000E+04	4.80300E+00	2.91510E+03	5.59264E+01
4.20000E+01	4.76000E+04	5.46100E+00	3.13290E+03	5.50956E+01
4.40000E+01	5.23000E+04	6.20100E+00	3.36200E+03	5.42935E+01
4.60000E+01	5.74000E+04	6.97400E+00	3.60310E+03	5.35257E+01
4.80000E+01	6.27000E+04	7.82900E+00	3.85660E+03	5.27809E+01
5.00000E+01	6.84000E+04	8.76600E+00	4.12340E+03	5.20704E+01
5.20000E+01	7.44000E+04	9.75300E+00	4.40410E+03	5.13829E+01
5.40000E+01	8.07000E+04	1.08390E+01	4.69960E+03	5.07240E+01
5.50000E+01	8.40000E+04	1.13980E+01	4.77950E+03	5.04031E+01
5.60000E+01	8.73000E+04	1.19740E+01	4.86550E+03	5.00937E+01
6.00000E+01	1.00900E+05	1.44080E+01	5.22720E+03	4.89363E+01
6.40000E+01	1.15300E+05	1.70720E+01	5.61700E+03	4.78878E+01

6.80000E+01	1.30500E+05	1.99670E+01	6.03560E+03	4.69195E+01
7.20000E+01	1.46600E+05	2.31090E+01	6.48470E+03	4.60142E+01
7.60000E+01	1.63600E+05	2.65300E+01	6.96670E+03	4.51605E+01
8.00000E+01	1.81500E+05	3.02300E+01	7.48490E+03	4.43527E+01
8.40000E+01	2.00500E+05	3.42430E+01	8.04350E+03	4.35849E+01
8.80000E+01	2.20600E+05	3.85860E+01	8.64770E+03	4.28515E+01
9.20000E+01	2.42000E+05	4.32730E+01	9.30360E+03	4.21640E+01
9.60000E+01	2.64900E+05	4.83390E+01	1.00193E+04	4.15108E+01
1.00000E+02	2.89300E+05	5.38320E+01	1.08049E+04	4.09035E+01
1.04000E+02	3.15500E+05	5.97530E+01	1.16736E+04	4.03362E+01
1.08000E+02	3.43800E+05	6.61680E+01	1.26429E+04	3.98034E+01
1.12000E+02	3.74400E+05	7.31250E+01	1.37367E+04	3.93106E+01
1.13000E+02	3.82400F+05	7.49340E+01	1.38010E+04	3.91903E+01
1.16000E+02	4.06500E+05	8.04440E+01	1.40139E+04	3.88580E+01
1.20000E+02	4.39200E+05	8.79280E+01	1.43095E+04	3.84397E+01
1.24000E+02	4.72300E+05	9.55590E+01	1.46193E+04	3.80616E+01
1.28000E+02	5.06100E+05	1.03388E+02	1.49443E+04	3.77063E+01
1.32000E+02	5.40500E+05	1.11365E+02	1.52857E+04	3.73740E+01
1.36000E+02	5.75700E+05	1.19539E+02	1.56447E+04	3.70646E+01
1.40000E+02	6.11600E+05	1.27911E+02	1.60229E+04	3.67724E+01
1.44000E+02	6.48300E+05	1.36464E+02	1.64219E+04	3.64974E+01
1.48000E+02	6.85800E+05	1.45230E+02	1.68437E+04	3.62339E+01
1.52000E+02	7.24400E+05	1.54211E+02	1.72907E+04	3.59817E+01
1.56000E+02	7.64000E+05	1.63421E+02	1.77654E+04	3.57468E+01
1.60000E+02	8.04700E+05	1.72878E+02	1.82709E+04	3.55234E+01
1.64000E+02	8.46600E+05	1.82566E+02	1.88110E+04	3.53114E+01
1.68000E+02	8.89900E+05	1.92533E+02	1.93899E+04	3.51109E+01
1.72000E+02	9.34600E+05	2.02763E+02	2.00131E+04	3.49218E+01
1.76000E+02	9.81000E+05	2.13306E+02	2.06869E+04	3.47384E+01
1.80000E+02	1.02910E+06	2.24178E+02	2.14194E+04	3.45723E+01
1.82000E+02	1.05400E+06	2.29737E+02	2.18113E+04	3.44863E+01

Output Level 1 - Input Echo: Detonating RV Identifier

RV RV A WITH A HEIGHT OF BURST OPTION A

Output Level 1 - Input Echo: Yield and Burst Altitude

```
BURST HEIGHT     1.00000E+02 FT
BURST YIELD      1.00000E+03 KT
```

Output Level 1 - Input Echo: Neutron Characteristics

```
NEUTRON OUTPUT INPUT    0.          N/KT
NEUTRON OUTPUT USED     2.41000E+23 N/KT

STORED NEUTRON TRANSMISSION DATA USED
   SET NUMBER     1
```

Output Level 2 - Expanded Input Echo: Neutron Transmission Data-

```
     30  DATA POINTS

   AIR MASS (G/CM**2)
     0.           1.00000E+00  2.00000E+00  3.00000E+00  4.00000E+00  5.00000E+00  6.00000E+00  8.00000E+00
     1.00000E+01  1.20000E+01  1.40000E+01  1.60000E+01  1.80000E+01  2.00000E+01  2.20000E+01  2.40000E+01
     2.70000E+01  3.00000E+01  3.50000E+01  4.00000E+01  5.00000E+01  6.00000E+01  8.00000E+01  1.00000E+02
     1.20000E+02  1.40000E+02  1.70000E+02  2.00000E+02  2.30000E+02  2.60000E+02

   NORMALIZED NEUTRON FLUENCE
     1.00000E+00  1.30000E+00  1.61000E+00  1.98000E+00  2.35000E+00  2.75000E+00  3.10000E+00  3.80000E+00
     4.30000E+00  4.70000E+00  5.00000E+00  5.30000E+00  5.42000E+00  5.43000E+00  5.41000E+00  5.27000E+00
     5.00000E+00  4.68000E+00  4.10000E+00  3.50000E+00  2.48000E+00  1.70000E+00  7.85000E-01  3.57000E-01
     1.58300E-01  6.87000E-02  1.91000E-02  5.22000E-03  1.41000E-03  3.77000E-04
```

Output Level 1 - Input Echo: X-ray Characteristics

```
X-RAY ENERGY FRACTION INPUT    0.
X-RAY ENERGY FRACTION USED     7.50000E-01

STORED X-RAY TRANSMISSION DATA USED
   SET NUMBER     2
```

Output Level 2 - Expanded Input Echo: X-ray transmission Data

```
     30  DATA POINTS

   AIR MASS (G/CM**2)
     0.           1.00000E-02  2.00000E-02  4.00000E-02  7.00000E-02  1.00000E-01  2.00000E-01  4.00000E-01
     7.00000E-01  1.00000E+00  1.50000E+00  2.00000E+00  3.00000E+00  4.00000E+00  5.00000E+00  6.00000E+00
     8.00000E+00  1.00000E+01  1.20000E+01  1.40000E+01  1.60000E+01  1.80000E+01  2.00000E+01  2.20000E+01
     2.50000E+01  3.00000E+01  4.00000E+01  5.00000E+01  7.00000E+01  1.00000E+02
```

NORMALIZED X-RAY FLUENCE

1.00000E+00	9.50000E-01	9.25000E-01	8.80000E-01	8.35000E-01	8.00000E-01	7.35000E-01	6.30000E-01
5.80000E-01	4.75000E-01	4.00000E-01	3.40000E-01	2.59000E-01	2.00000E-01	1.61000E-01	1.31000E-01
8.90000E-02	6.23000E-01	4.45000E-02	3.10000E-02	2.05000E-02	1.42000E-02	9.80000E-03	6.85000E-03
4.07000E-03	1.63000E-03	2.98000E-03	5.40000E-05	1.95000E-06	1.60000E-08		

Output Level 3 - Initial Expanded Blast Output Data

```
YD1 =  1.00 Z1 =       .100 Z2 =      0.000 Z0 =      0.000
T =       0.000  IV =     2
TSTAR =       0.000 YSTAR =      0.000
```

Output Level 3 - Detailed Blast Exclusion Region Data

TIME =   0.00

	Y	X	AREA	MECH
*	22.733	0.000	0.00	1
*	22.609	5.039	.63	1
*	21.415	8.538	16.84	1
*	20.283	10.078	37.92	1
*	18.896	13.715	70.92	1
*	17.660	15.117	106.55	1
*	16.376	18.466	149.65	1
*	14.752	20.155	212.37	1
*	13.857	21.051	249.27	1
*	12.123	22.675	325.08	1
*	11.337	23.461	361.33	1
*	9.250	25.194	462.89	1
*	8.818	25.626	484.85	1
*	4.272	27.714	727.34	1
*	3.779	28.206	754.89	1
*	-1.260	28.562	1040.93	1
*	-6.299	30.611	1339.10	1
*	-11.337	30.574	1647.41	1
*	-16.376	30.361	1954.45	1
*	-21.415	29.235	2254.75	1
*	-24.710	27.714	2442.36	1
*	-26.454	26.703	2537.28	1
*	-28.652	25.194	2651.35	1
*	-28.973	24.951	2667.47	1
*	-31.654	22.675	2795.12	1
*	-34.012	20.246	2896.35	1
*	-34.093	20.155	2899.61	1
*	-36.532	16.944	2990.09	1

	Y	X	AREA	MECH
*	-37.660	15.117	3026.27	1
*	-39.051	12.019	3064.01	1
*	-39.665	10.078	3077.58	1
*	-40.987	5.039	3097.57	1
*	-41.405	-.000	3099.67	1

Output Level 3 - Simplified Blast Exclusion Region Data

DU = -22.7334, DC = 30.6115, DD = 41.4050, AREA = 3099.6723
LENGTH = 32.0692 CENTER = -9.3358 WIDTH = 30.6115

TIME = -3.78

	Y	X	AREA	MECH
*	18.053	0.000	0.00	1
*	17.919	5.039	.67	1
*	16.376	8.881	22.15	1
*	15.481	10.078	39.12	1
*	13.857	13.904	78.08	1
*	12.736	15.117	110.59	1
*	11.337	16.515	154.84	1
*	10.172	17.636	194.66	1
*	8.818	18.990	244.23	1
*	7.459	20.155	297.43	1
*	6.299	21.316	345.56	1
*	2.356	22.675	518.99	1
*	1.260	23.771	569.91	1
*	-3.089	25.194	782.83	1
*	-3.779	25.885	818.10	1
*	-8.818	25.988	1079.48	1
*	-13.857	25.839	1340.63	1
*	-18.896	25.510	1599.37	1
*	-21.857	25.194	1749.54	1
*	-23.935	24.170	1852.08	1
*	-26.903	22.675	1991.12	1

*	-28.973	21.076	2081.71	1
*	-30.115	20.155	2128.76	1
*	-31.493	18.777	2182.42	1
*	-32.634	17.636	2223.97	1
*	-34.012	15.887	2270.18	1
*	-34.602	15.117	2288.47	1
*	-36.532	11.716	2340.24	1
*	-37.287	10.078	2356.71	1
*	-38.669	5.039	2377.60	1
*	-39.241	-.000	2380.48	1

DU = -18.0530, DC = 25.9882, DD = 39.2413, AREA = 2380.4800
LENGTH = 28.6471 CENTER = -10.5942 WIDTH = 25.9882

TIME = -7.56

	Y	X	AREA	MECH
*	13.296	0.000	0.00	1
*	13.137	5.039	.80	1
*	11.337	6.838	22.17	1
*	10.804	7.558	29.85	1
*	8.818	11.825	68.35	1
*	8.056	12.597	86.95	1
*	6.299	14.355	134.32	1
*	5.404	15.117	160.67	1
*	3.779	16.742	212.45	1
*	2.560	17.636	254.37	1
*	1.260	18.936	301.92	1
*	-3.779	19.216	494.16	1
*	-8.818	21.254	698.08	1
*	-13.857	21.061	911.30	1
*	-18.896	20.647	1121.45	1
*	-23.935	18.097	1316.68	1

*	-26.408	17.636	1405.05	1
*	-26.454	17.599	1406.68	1
*	-29.426	15.117	1503.90	1
*	-31.493	12.792	1561.59	1
*	-31.684	12.597	1566.44	1
*	-34.012	8.582	1615.76	1
*	-34.466	7.558	1623.09	1
*	-35.748	2.519	1636.00	1
*	-35.748	-2.519	1636.00	1

DU = -13.2955, DC = 21.2540, DD = 35.7478, AREA = 1635.9994
LENGTH = 24.5216 CENTER = -11.2261 WIDTH = 21.2540

TIME = -11.34

	Y	X	AREA	MECH
*	8.398	0.000	0.00	1
*	6.000	5.039	12.08	1
*	3.779	9.541	44.46	1
*	3.166	10.078	56.50	1
*	1.260	11.984	98.55	1
*	.283	12.597	122.56	1
*	-1.260	14.140	163.80	1
*	-6.299	14.372	307.47	1
*	-11.337	14.238	451.63	1
*	-16.376	13.878	593.30	1
*	-19.893	12.597	686.42	1
*	-21.415	11.139	722.54	1
*	-24.501	10.078	788.02	1
*	-26.454	7.964	823.25	1
*	-26.860	7.558	829.55	1
*	-28.973	2.750	851.34	1
*	-29.204	2.519	852.55	1

* -29.204 -2.519 852.55 1

DU = -8.3978, DC = 14.3719, DD = 29.2038, AREA = 852.5500
LENGTH = 18.8008 CENTER = -10.4030 WIDTH = 14.3719

TIME = -15.12

	Y	X	AREA	MECH
*	-1.546	0.000	0.00	1
*	-4.337	5.039	14.06	1
*	-6.299	7.001	37.68	1
*	-11.337	6.720	106.81	1
*	-13.018	5.039	126.58	1
*	-13.857	4.187	134.31	1
*	-15.524	2.519	145.49	1
*	-15.524	-2.519	145.49	1

DU = 1.5464, DC = 7.0007, DD = 15.5241, AREA = 145.4948
LENGTH = 6.9888 CENTER = -8.5353 WIDTH = 7.0007

TIME = -18.90

Y	X	AREA	MECH

NO FOOTPRINT

TIME = 3.78

	Y	X	AREA	MECH
*	27.345	0.000	0.00	1
*	27.180	5.039	.83	1
*	26.454	5.765	8.68	1
*	25.137	7.558	26.23	1
*	24.745	12.597	34.13	1
*	22.141	17.636	112.83	1
*	21.415	18.362	138.98	1
*	19.747	20.155	203.24	1
*	18.896	21.007	238.27	1
*	17.227	22.675	311.15	1
*	16.376	23.526	350.47	1
*	14.625	25.194	435.77	1
*	13.857	25.963	475.09	1
*	11.932	27.714	578.41	1
*	11.337	28.308	611.71	1
*	9.041	30.233	746.12	1
*	8.818	30.457	759.68	1
*	3.873	32.752	1072.26	1
*	3.779	32.846	1078.41	1
*	-1.260	33.194	1411.18	1
*	-6.299	34.857	1754.07	1
*	-11.337	34.792	2105.02	1
*	-16.376	33.948	2451.39	1
*	-21.415	32.325	2785.33	1
*	-25.618	30.233	3048.27	1
*	-26.454	29.702	3098.36	1
*	-29.320	27.714	3262.89	1
*	-31.493	25.995	3379.61	1
*	-32.377	25.194	3424.86	1
*	-34.012	23.347	3504.25	1
*	-34.614	22.675	3531.95	1
*	-36.532	20.173	3614.11	1
*	-36.545	20.155	3614.67	1

*	-39.051	16.170	3705.69	1
*	-39.597	15.117	3722.75	1
*	-41.570	10.117	3772.56	1
*	-41.583	10.078	3772.81	1
*	-42.622	5.039	3788.52	1
*	-43.120	-.000	3791.03	1
*	-7.749	0.000	0.00	1
*	-7.792	5.039	.22	1
*	-5.039	7.785	-35.09	1
*	.000	7.734	-113.28	1
*	5.039	7.761	-191.36	1
*	5.222	7.558	-194.17	1
*	7.558	5.215	-224.01	1
*	7.754	5.039	-226.02	1
*	7.718	-.000	-225.83	1

DU = -7.7539, DC = 7.7846, DD = 7.7925, AREA = -225.8332
RMAX = 43.1198 RMIN = 7.7176 PHI1 = 180.0000 PHI2 = 180.0000

TIME = 7.56

	Y	X	AREA	MECH
*	31.807	0.000	0.00	1
*	29.887	5.039	9.67	1
*	29.658	10.078	13.13	1
*	27.237	15.117	74.12	1
*	26.454	18.110	100.15	1
*	24.599	20.155	171.13	1
*	23.935	22.815	199.68	1
*	21.705	25.194	306.72	1
*	21.415	25.484	321.41	1
*	19.161	27.714	441.32	1
*	18.896	27.979	456.10	1

*	16.466	30.233	597.56	1
*	16.376	30.323	602.97	1
*	12.696	32.752	835.09	1
*	11.337	33.006	924.45	1
*	7.637	35.272	1177.13	1
*	6.299	35.425	1271.72	1
*	1.260	37.218	1637.76	1
*	-3.779	37.912	2016.33	1
*	-8.818	37.872	2398.19	1
*	-9.776	37.791	2470.68	1
*	-11.337	37.637	2588.45	1
*	-16.376	36.683	2962.94	1
*	-21.415	34.904	3323.66	1
*	-25.524	32.752	3601.65	1
*	-26.454	32.173	3662.03	1
*	-29.426	30.233	3847.48	1
*	-31.493	28.401	3968.69	1
*	-32.261	27.714	4011.82	1
*	-34.012	25.963	4105.79	1
*	-34.781	25.194	4145.12	1
*	-36.532	23.188	4229.82	1
*	-36.936	22.675	4248.38	1
*	-39.051	19.345	4337.24	1
*	-39.999	17.636	4372.30	1
*	-41.570	14.284	4422.46	1
*	-42.223	12.597	4440.01	1
*	-43.632	7.558	4468.40	1
*	-44.249	2.519	4474.62	1
*	-44.249	-2.519	4474.62	1
*	-13.008	0.000	0.00	1
*	-13.048	5.039	.20	1
*	-10.533	10.078	-37.81	1
*	-10.078	10.533	-47.19	1
*	-5.415	12.597	-155.05	1
*	-5.039	13.032	-164.68	1
*	.000	12.978	-295.74	1

*	5.039	13.003	-426.66	1
*	10.078	10.472	-544.95	1
*	10.472	10.078	-553.05	1
*	12.597	5.366	-585.87	1
*	12.975	5.039	-589.81	1
*	12.940	-.000	-589.63	1

DU = -12.9755, DC = 13.0317, DD = 13.0476, AREA = -589.6280
RMAX = 44.3204 RMIN = 12.9402 PHI1 = 180.0000 PHI2 = 180.0000

TIME = 11.34

	Y	X	AREA	MECH
*	34.592	0.000	0.00	1
*	34.514	5.039	.40	1
*	34.234	10.078	4.63	1
*	31.911	15.117	63.15	1
*	31.493	17.740	76.89	1
*	29.370	20.155	157.32	1
*	28.973	22.583	174.28	1
*	28.907	22.675	177.28	1
*	26.454	25.346	295.09	1
*	24.133	27.714	418.24	1
*	23.935	27.912	429.27	1
*	21.578	30.233	566.27	1
*	21.415	30.396	576.17	1
*	18.947	32.752	732.01	1
*	18.896	32.804	735.39	1
*	15.170	35.272	988.99	1
*	13.857	35.947	1082.55	1
*	9.833	37.791	1379.25	1
*	8.818	38.158	1456.35	1
*	3.779	39.672	1848.52	1

*	-1.260	40.413	2252.06	1
*	-6.299	40.560	2660.07	1
*	-9.681	40.311	2933.64	1
*	-11.337	40.052	3066.72	1
*	-16.376	38.913	3464.61	1
*	-21.415	37.035	3847.30	1
*	-24.895	35.272	4098.94	1
*	-26.454	34.354	4207.46	1
*	-28.722	32.752	4359.63	1
*	-28.973	32.559	4376.08	1
*	-31.901	30.233	4559.93	1
*	-34.012	28.122	4683.11	1
*	-34.423	27.714	4706.03	1
*	-36.532	25.311	4817.85	1
*	-36.624	25.194	4822.61	1
*	-39.051	21.713	4936.37	1
*	-39.996	20.155	4975.96	1
*	-41.570	17.118	5034.62	1
*	-42.459	15.117	5063.27	1
*	-44.027	10.078	5102.78	1
*	-45.078	5.039	5118.67	1
*	-45.376	-.000	5120.17	1
*	-18.308	0.000	0.00	1
*	-18.341	5.039	.16	1
*	-15.795	10.078	-38.32	1
*	-15.117	10.723	-52.44	1
*	-13.238	12.597	-96.24	1
*	-12.597	13.238	-112.80	1
*	-10.714	15.117	-166.20	1
*	-10.078	15.785	-185.86	1
*	-8.221	17.636	-247.92	1
*	-7.558	18.354	-271.76	1
*	-2.519	18.288	-456.40	1
*	2.519	18.274	-640.63	1
*	7.558	18.318	-825.01	1
*	8.178	17.636	-847.30	1

*	10.078	15.730	-910.68	1
*	10.657	15.117	-928.56	1
*	12.597	13.168	-983.42	1
*	13.168	12.597	-998.13	1
*	15.117	10.638	-1043.41	1
*	15.710	10.078	-1055.71	1
*	17.636	8.137	-1090.78	1
*	18.273	7.558	-1100.78	1
*	18.220	2.519	-1100.24	1
*	18.220	-2.519	-1100.24	1

DU = -18.2733, DC = 18.3535, DD = 18.3411, AREA = -1100.2437
RMAX = 45.3763 RMIN = 18.2231 PHI1 = 180.0000 PHI2 = 180.0000

TIME = 15.12

	Y	X	AREA	MECH
*	39.134	0.000	0.00	1
*	39.022	5.039	.57	1
*	38.012	10.078	15.84	1
*	36.547	15.117	52.75	1
*	36.532	15.243	53.21	1
*	35.432	17.636	89.36	1
*	34.012	20.599	143.65	1
*	32.748	22.675	198.36	1
*	31.493	24.673	257.79	1
*	31.103	25.194	277.23	1
*	28.973	27.930	390.36	1
*	26.809	30.233	516.28	1
*	26.454	30.616	537.85	1
*	24.089	32.752	687.72	1
*	23.935	32.889	697.85	1
*	20.752	35.272	914.75	1

*	18.896	36.522	1048.05	1
*	16.645	37.791	1215.30	1
*	16.376	37.936	1235.66	1
*	11.337	40.195	1629.35	1
*	6.299	41.675	2041.87	1
*	1.260	42.547	2466.25	1
*	-3.779	42.791	2896.26	1
*	-8.818	42.511	3326.09	1
*	-13.857	41.549	3749.66	1
*	-18.896	40.022	4160.68	1
*	-23.772	37.791	4540.11	1
*	-23.935	37.712	4552.40	1
*	-27.796	35.272	4834.22	1
*	-28.973	34.367	4916.21	1
*	-30.951	32.752	5048.94	1
*	-31.493	32.305	5084.20	1
*	-33.867	30.233	5232.66	1
*	-34.012	30.088	5241.44	1
*	-36.084	27.714	5361.20	1
*	-36.532	27.148	5385.75	1
*	-38.107	25.194	5468.18	1
*	-39.051	23.754	5514.41	1
*	-39.775	22.675	5548.02	1
*	-41.570	19.606	5623.94	1
*	-42.514	17.636	5659.07	1
*	-44.090	13.540	5708.21	1
*	-44.428	12.597	5717.04	1
*	-45.633	7.558	5741.33	1
*	-46.217	2.519	5747.22	1
*	-46.217	-2.519	5747.22	1
*	-23.627	0.000	0.00	1
*	-23.661	5.039	.17	1
*	-21.083	10.078	-38.80	1
*	-20.155	10.950	-58.30	1
*	-18.506	12.597	-97.15	1
*	-17.636	16.046	-122.06	1

*	-16.042	17.636	-175.76	1
*	-15.117	18.573	-209.25	1
*	-10.936	20.155	-371.16	1
*	-10.078	21.072	-406.55	1
*	-5.886	22.675	-589.92	1
*	-5.039	23.627	-629.14	1
*	.000	23.581	-867.02	1
*	5.039	23.602	-1104.76	1
*	10.078	21.020	-1329.60	1
*	10.886	20.155	-1362.80	1
*	12.597	18.438	-1428.92	1
*	15.963	17.636	-1550.35	1
*	17.636	15.953	-1606.54	1
*	18.491	15.117	-1633.11	1
*	20.155	10.850	-1676.32	1
*	20.983	10.078	-1693.65	1
*	22.675	5.798	-1720.50	1
*	23.535	5.039	-1729.82	1
*	23.509	-.000	-1729.69	1

BU = -23.5349, BC = 23.6267, BB = 23.6609, AREA = -1729.6927
RMAX = 46.2860 RMIN = 22.3306 PHI1 = 180.0000 PHI2 = 180.0000

TIME = 18.90

	Y	X	AREA	MECH
*	42.317	0.000	0.00	1
*	42.068	5.039	1.25	1
*	42.057	5.467	1.37	1
*	41.779	7.558	4.98	1
*	40.523	12.597	30.31	1
*	38.774	17.636	83.19	1
*	37.018	21.288	151.52	1

*	36.195	22.675	187.70	1
*	34.499	25.378	269.22	1
*	32.770	27.714	361.00	1
*	31.979	28.729	405.63	1
*	30.606	30.233	486.58	1
*	29.460	31.478	557.33	1
*	28.123	32.752	643.23	1
*	26.941	33.837	721.95	1
*	25.181	35.272	843.57	1
*	24.421	35.858	897.59	1
*	21.643	37.791	1102.22	1
*	19.382	39.147	1276.14	1
*	17.164	40.311	1452.38	1
*	16.863	40.461	1476.72	1
*	11.824	42.471	1894.60	1
*	6.785	43.845	2329.54	1
*	1.746	44.644	2775.42	1
*	-3.293	44.743	3225.83	1
*	-8.331	44.401	3675.02	1
*	-13.370	43.337	4117.12	1
*	-18.409	41.717	4545.69	1
*	-21.701	40.311	4815.74	1
*	-23.448	39.540	4955.22	1
*	-26.188	37.791	5167.10	1
*	-28.487	36.333	5337.50	1
*	-29.858	35.272	5435.69	1
*	-31.006	34.349	5515.63	1
*	-32.818	32.752	5637.23	1
*	-33.526	32.045	5683.06	1
*	-35.338	30.233	5795.91	1
*	-36.045	29.402	5838.09	1
*	-37.409	27.714	5916.02	1
*	-38.564	26.255	5978.35	1
*	-39.367	25.194	6019.64	1
*	-41.084	22.384	6101.33	1
*	-42.296	20.155	6152.88	1

TIME = 22.67

	Y	X	AREA	MECH
*	44.929	0.000	0.00	1
*	44.637	5.039	1.47	1
*	43.934	9.779	11.90	1
*	43.868	10.078	13.20	1
*	42.402	15.117	50.13	1
*	40.371	20.155	121.77	1
*	38.895	22.916	185.36	1
*	37.537	25.194	250.67	1
*	36.375	26.937	311.24	1
*	35.829	27.714	341.11	1
*	33.856	30.130	455.23	1
*	33.764	30.233	460.78	1
*	31.336	32.923	614.09	1
*	28.707	35.272	793.41	1
*	26.298	37.216	968.06	1
*	25.463	37.791	1030.63	1
*	23.778	38.937	1159.93	1
*	21.518	40.311	1339.05	1
*	21.259	40.467	1359.99	1
*	16.525	42.830	1754.32	1
*	16.220	42.966	1780.47	1
*	11.181	44.665	2222.03	1
*	6.142	45.783	2677.78	1
*	1.103	46.400	3142.28	1
*	-3.935	46.406	3609.91	1
*	-8.974	45.859	4074.82	1
*	-11.235	45.350	4281.06	1
*	-11.494	45.291	4304.47	1
*	-16.533	43.843	4753.60	1
*	-21.571	41.861	5185.45	1

*	-43.603	17.260	6201.81	1
*	-44.523	15.117	6231.59	1
*	-45.889	10.078	6265.99	1
*	-46.857	5.039	6280.63	1
*	-47.078	-.000	6281.74	1
*	-28.971	0.000	0.00	1
*	-28.993	5.039	.11	1
*	-26.398	10.078	-39.12	1
*	-25.194	13.793	-67.85	1
*	-23.868	15.117	-106.18	1
*	-22.675	16.274	-143.65	1
*	-21.309	17.636	-189.95	1
*	-20.155	18.776	-231.97	1
*	-18.772	20.155	-285.82	1
*	-17.636	21.306	-332.93	1
*	-16.264	22.675	-393.29	1
*	-15.117	23.858	-446.66	1
*	-13.776	25.194	-512.44	1
*	-12.597	26.448	-573.30	1
*	-7.558	26.328	-839.23	1
*	-2.519	28.936	-1117.69	1
*	2.519	28.925	-1409.24	1
*	6.144	27.714	-1614.53	1
*	7.558	26.296	-1690.92	1
*	12.597	26.387	-1956.38	1
*	16.200	22.675	-2133.13	1
*	20.155	18.685	-2296.73	1
*	23.763	15.117	-2418.67	1
*	26.282	10.078	-2482.14	1
*	27.714	6.072	-2505.26	1
*	28.860	5.039	-2517.99	1
*	28.830	-.000	-2517.84	1

DU = -28.8596, DC = 28.9356, DD = 28.9932, AREA = -2517.8427
RMAX = 47.1275 RMIN = 27.3611 PHI1 = 180.0000 PHI2 = 180.0000

*	-24.454	40.311	5422.29	1
*	-26.610	39.010	5593.35	1
*	-28.412	37.791	5731.72	1
*	-29.130	37.256	5785.59	1
*	-31.561	35.272	5961.89	1
*	-31.649	35.196	5968.13	1
*	-34.269	32.752	6146.17	1
*	-36.688	30.145	6298.30	1
*	-38.672	27.714	6413.10	1
*	-39.207	26.930	6442.34	1
*	-40.390	25.194	6504.00	1
*	-41.727	23.044	6568.47	1
*	-41.953	22.675	6578.80	1
*	-44.246	18.107	6672.34	1
*	-44.458	17.636	6679.92	1
*	-46.193	12.597	6732.37	1
*	-47.307	7.558	6754.81	1
*	-47.780	2.519	6759.59	1
*	-47.780	-2.519	6759.59	1
*	-31.637	0.000	0.00	1
*	-31.660	5.039	.11	1
*	-31.735	10.078	1.26	1
*	-30.233	11.481	-31.13	1
*	-29.116	12.597	-58.04	1
*	-27.714	16.526	-98.86	1
*	-26.601	17.636	-136.86	1
*	-25.194	21.630	-192.11	1
*	-24.147	22.675	-238.51	1
*	-22.675	24.147	-307.44	1
*	-21.625	25.194	-359.24	1
*	-20.155	26.687	-435.49	1
*	-16.512	27.714	-633.67	1
*	-15.117	29.170	-713.07	1
*	-11.459	30.233	-930.33	1
*	-10.078	31.714	-1015.91	1
*	-5.039	31.629	-1335.08	1

*	.000	31.595	-1653.66	1
*	5.039	31.612	-1972.15	1
*	10.078	31.678	-2291.06	1
*	15.117	29.118	-2597.40	1
*	16.455	27.714	-2673.47	1
*	17.636	26.528	-2737.52	1
*	21.545	25.194	-2939.69	1
*	22.675	24.057	-2995.35	1
*	24.057	22.675	-3059.94	1
*	25.194	21.530	-3110.21	1
*	26.591	20.155	-3168.45	1
*	27.714	16.418	-3209.50	1
*	29.082	15.117	-3252.64	1
*	30.233	11.358	-3283.12	1
*	31.612	10.078	-3312.69	1
*	31.551	5.039	-3311.75	1
*	31.520	-.000	-3311.60	1

DU = -31.6124, DC = 31.7141, DD = 31.7352, AREA = -3311.5977
RMAX = 47.9068 RMIN = 31.5196 PHI1 = 180.0000 PHI2 = 180.0000

TIME = 26.45

	Y	X	AREA	MECH
*	47.070	0.000	0.00	1
*	46.813	5.039	1.30	1
*	45.969	10.078	14.06	1
*	44.651	15.117	47.27	1
*	43.259	18.621	94.23	1
*	42.586	20.155	120.33	1
*	40.739	23.712	201.32	1
*	39.916	25.194	241.58	1
*	38.220	27.690	331.28	1

*	38.202	27.714	332.25	1
*	35.701	31.019	479.19	1
*	34.073	32.752	582.96	1
*	33.181	33.645	642.20	1
*	31.554	35.272	754.34	1
*	30.662	36.117	818.04	1
*	28.636	37.791	967.76	1
*	28.142	38.186	1005.27	1
*	24.933	40.311	1257.18	1
*	23.103	41.475	1406.82	1
*	20.638	42.830	1614.68	1
*	20.584	42.859	1619.29	1
*	15.545	44.927	2061.64	1
*	10.506	46.514	2522.40	1
*	5.467	47.514	2996.19	1
*	.429	47.883	3476.88	1
*	-4.610	47.699	3958.50	1
*	-9.649	46.946	4435.40	1
*	-14.688	45.823	4902.85	1
*	-16.056	45.350	5027.54	1
*	-17.207	44.962	5131.56	1
*	-21.944	42.830	5547.44	1
*	-22.246	42.675	5573.24	1
*	-26.561	40.311	5931.29	1
*	-27.285	39.851	5989.35	1
*	-30.154	37.791	6212.09	1
*	-32.324	35.918	6372.04	1
*	-33.015	35.272	6421.25	1
*	-34.843	33.569	6547.11	1
*	-35.649	32.752	6600.55	1
*	-37.363	30.845	6709.53	1
*	-37.890	30.233	6741.74	1
*	-39.882	27.435	6856.62	1
*	-41.394	25.194	6936.19	1
*	-42.402	23.485	6985.24	1
*	-42.895	22.675	7008.02	1

```
* -44.921  18.311 7091.05     1
* -45.223  17.636 7101.93     1
* -46.966  12.597 7154.61     1
* -48.031   7.558 7176.07     1
* -48.545   2.519 7181.25     1
* -48.545  -2.519 7181.25     1
* -37.010   0.000    0.00     1
* -37.028   5.039     .09     1
* -37.099  10.078    1.17     1
* -35.272  11.789  -38.78     1
* -34.464  12.597  -58.49     1
* -32.752  16.810 -108.82     1
* -31.927  17.636 -137.26     1
* -30.233  21.893 -204.21     1
* -29.429  22.675 -240.04     1
* -27.714  24.367 -320.74     1
* -26.885  25.194 -361.80     1
* -25.194  26.885 -449.87     1
* -24.364  27.714 -495.20     1
* -22.675  29.426 -591.72     1
* -21.866  30.233 -639.97     1
* -20.155  31.983 -746.40     1
* -16.783  32.752 -964.68     1
* -15.117  34.499-1076.78     1
* -11.755  35.272-1311.34     1
* -10.078  37.061-1432.64     1
*  -5.039  36.983-1805.74     1
*    .000  36.964-2178.35     1
*   5.039  36.970-2550.89     1
*  10.078  37.031-2923.77     1
*  15.117  34.462-3284.01     1
*  16.742  32.752-3393.27     1
*  17.636  31.855-3451.02     1
*  21.801  30.233-3709.65     1
*  22.675  29.355-3761.69     1
*  24.293  27.714-3854.05     1
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*  25.194  26.807-3903.18    1
*  26.807  25.194-3987.04    1
*  27.714  24.281-4031.90    1
*  29.344  22.675-4108.44    1
*  30.233  21.778-4147.97    1
*  31.903  20.155-4218.01    1
*  32.752  16.698-4249.31    1
*  34.417  15.117-4302.26    1
*  35.272  11.660-4325.15    1
*  36.974  10.078-4362.16    1
*  36.906   5.039-4361.13    1
*  36.883   -.000-4361.01    1

        DU =   -36.9744, DC =    37.0611, BD =    37.0991, AREA = -4361.0129
        RMAX =   48.6262 RMIN =   36.4115 PHI1 =  180.0000 PHI2 =  180.0000


TIME =   30.23

      Y        X      AREA    MECH
*  48.674   0.000     0.00    1
*  48.444   5.039     1.16    1
*  47.616  10.078    13.68    1
*  46.328  15.117    46.14    1
*  45.081  18.530    88.09    1
*  44.364  20.155   115.82    1
*  42.561  23.737   194.94    1
*  41.762  25.194   234.04    1
*  40.042  27.742   325.11    1
*  38.307  30.233   425.69    1
*  37.522  31.184   473.88    1
*  36.125  32.752   563.20    1
*  35.003  33.948   638.06    1
*  33.679  35.272   729.73    1
```

*	32.484	36.439	815.43	1
*	30.846	37.791	936.97	1
*	29.964	38.472	1004.24	1
*	27.550	40.311	1194.44	1
*	27.445	40.386	1202.93	1
*	23.499	42.830	1531.24	1
*	22.406	43.420	1625.56	1
*	18.250	45.350	1994.49	1
*	17.367	45.740	2074.90	1
*	12.328	47.416	2544.30	1
*	7.289	48.386	3027.04	1
*	2.250	48.983	3517.67	1
*	-2.788	48.983	4011.31	1
*	-7.827	48.386	4501.94	1
*	-10.606	47.869	4769.44	1
*	-12.866	47.346	4984.60	1
*	-17.905	45.675	5453.32	1
*	-22.944	43.446	5902.38	1
*	-24.098	42.830	6001.98	1
*	-25.463	42.081	6117.88	1
*	-28.093	40.311	6334.55	1
*	-30.502	38.550	6524.54	1
*	-31.393	37.791	6592.54	1
*	-33.021	36.405	6713.38	1
*	-34.238	35.272	6800.55	1
*	-35.541	33.969	6890.79	1
*	-36.757	32.752	6971.93	1
*	-38.060	31.202	7055.28	1
*	-38.829	30.233	7102.50	1
*	-40.580	27.982	7204.42	1
*	-40.775	27.714	7215.30	1
*	-43.099	23.851	7335.14	1
*	-43.770	22.675	7366.35	1
*	-45.619	18.416	7442.31	1
*	-45.964	17.636	7454.76	1
*	-47.612	12.597	7504.59	1

*	-48.734	7.558	7527.20	1
*	-49.311	2.519	7533.01	1
*	-49.311	-2.519	7533.01	1
*	-42.363	0.000	0.00	1
*	-42.381	5.039	.09	1
*	-39.752	10.078	-39.65	1
*	-39.862	15.117	-36.89	1
*	-37.324	20.155	-126.40	1
*	-35.272	22.143	-213.19	1
*	-34.740	22.675	-237.02	1
*	-32.752	24.626	-331.04	1
*	-32.184	25.194	-359.34	1
*	-30.233	29.756	-466.57	1
*	-29.756	30.233	-495.17	1
*	-27.714	32.294	-622.89	1
*	-24.607	32.752	-824.94	1
*	-22.675	34.726	-955.35	1
*	-22.127	35.272	-993.68	1
*	-20.155	37.310	-1136.80	1
*	-17.069	37.791	-1368.58	1
*	-15.117	39.843	-1520.16	1
*	-10.078	39.733	-1921.13	1
*	-5.039	42.356	-2334.77	1
*	.000	42.330	-2761.49	1
*	5.039	42.355	-3188.20	1
*	10.078	39.715	-3601.74	1
*	15.117	39.810	-4002.46	1
*	20.155	37.270	-4390.86	1
*	22.086	35.272	-4530.90	1
*	22.675	34.681	-4572.09	1
*	24.566	32.752	-4699.65	1
*	25.194	32.121	-4740.38	1
*	29.695	30.233	-5021.00	1
*	30.233	29.691	-5053.27	1
*	32.223	27.714	-5167.48	1
*	32.752	24.550	-5195.17	1

```
 *  34.665  22.675-5285.49     1
 *  35.272  22.062-5312.64     1
 *  37.254  20.155-5396.33     1
 *  37.791  17.005-5416.29     1
 *  39.782  15.117-5480.22     1
 *  39.671  10.078-5477.43     1
 *  42.309   5.039-5517.30     1
 *  42.284   -.000-5517.18     1

        DU =   -42.3089, DC =    42.3561, DD =    42.3809, AREA = -5517.1778
        RMAX =   49.3750 RMIN =   40.8231 PHI1 =  180.0000 PHI2 =  180.0000


TIME =   34.01

      Y        X      AREA    MECH
 *  49.786   0.000    0.00     1

        DU =   -49.7858, DC =     0.0000, DD =   -49.7858, AREA =     0.0000
        RMAX =   49.7858 RMIN =   47.6981 PHI1 =  180.0000 PHI2 =  180.0000


TIME =   37.79

      Y        X      AREA    MECH


                  NO FOOTPRINT
```

BLAST FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 1.00E-01
3 FAILURE CRITERIA = 1.00E+00, 1.00E+70, 1.00E+70

FOOTPRINT TIME HISTORY

	RECTANGLE			CIRCLE OR ANNULUS			
T (SEC)	LENGTH (KFT)	WIDTH DR (KFT)	OFFSET (KFT)	RMAX (KFT)	RMIN (KFT)	PHI1 (DEG)	PHI2 (DEG)
-18.896	0.000	0.000	-8.535	0.000	0.000	0.000	0.000
-15.117	6.989	7.001	-8.535	0.000	0.000	0.000	0.000
-11.337	18.801	14.372	-10.403	0.000	0.000	0.000	0.000
-7.558	24.522	21.254	-11.226	0.000	0.000	0.000	0.000
-3.779	28.647	25.988	-10.594	0.000	0.000	0.000	0.000
0.000	32.069	30.611	-9.336	41.405	0.000	180.000	180.000
3.779	0.000	0.000	0.000	43.120	7.718	180.000	180.000
7.558	0.000	0.000	0.000	44.320	12.940	180.000	180.000
11.337	0.000	0.000	0.000	45.376	18.223	180.000	180.000
15.117	0.000	0.000	0.000	46.286	22.331	180.000	180.000
18.896	0.000	0.000	0.000	47.127	27.361	180.000	180.000
22.675	0.000	0.000	0.000	47.907	31.520	180.000	180.000
26.454	0.000	0.000	0.000	48.626	36.412	180.000	180.000
30.233	0.000	0.000	0.000	49.375	40.823	180.000	180.000
34.012	0.000	0.000	0.000	49.786	47.698	180.000	180.000
37.791	0.000	0.000	0.000	49.786	49.786	180.000	180.000

Output Level 2 - Reduced Ejecta Exclusion Region Data

EJECTA FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 1.00E+02
CRITICAL DIAMETER = 1.000E+00 CRITICAL DENSITY = 0.

FOOTPRINT TIME HISTORY

T (SEC)	LENGTH (KFT)	WIDTH (KFT)	DR OFFSET (KFT)
0.000	0.000	0.000	0.000
5.000	9.668	8.119	1.549
10.000	13.716	11.428	2.289
15.000	17.089	14.223	2.866
20.000	19.704	16.506	3.198
25.000	21.546	18.274	3.272
30.000	22.665	19.530	3.135
35.000	23.074	20.272	2.802
40.000	22.790	20.499	2.291
45.000	21.448	19.780	1.668
50.000	18.685	17.765	.920
55.000	14.670	14.455	.215
60.000	0.000	0.000	0.000

DUST FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 1.00E+02
INTERCEPTED KE = 2.06E+05 CLOUD CUTOFF = 1.50E+03

FOOTPRINT TIME HISTORY

T (SEC)	LENGTH (KFT)	WIDTH (KFT)	DR OFFSET (KFT)
0.000	0.000	0.000	0.000
30.000	7.074	4.610	2.473
60.000	12.959	7.202	5.728
90.000	19.178	9.350	9.955
120.000	25.069	11.253	13.992
150.000	30.071	12.991	17.048
180.000	34.135	14.609	19.777
210.000	37.502	16.133	21.727
240.000	40.117	17.581	22.743
270.000	41.984	18.966	22.782
300.000	41.773	20.297	21.684
330.000	41.835	21.582	20.131
360.000	42.139	22.825	19.353
390.000	42.710	24.032	18.705
420.000	43.119	25.207	17.810
450.000	43.965	26.352	17.272
480.000	44.596	27.469	17.079
510.000	45.638	28.563	16.596
540.000	46.462	29.633	16.455
570.000	47.380	30.683	16.338
600.000	48.391	31.713	16.241
630.000	48.391	31.713	16.241
660.000	48.391	31.713	16.241
690.000	48.391	31.713	16.241
720.000	48.391	31.713	16.241
750.000	48.391	31.713	16.241

780.000	48.391	31.713	16.241
810.000	48.391	31.713	16.241
840.000	48.391	31.713	16.241
870.000	48.391	31.713	16.241
900.000	0.000	0.000	16.241

DETAILED PROGRAM OUTPUT EDIT FOLLOWS

```
BURST YIELD (KT) =  1.0000E+03
IPHASE           =  2
ALTITUDE (KM)    =  3.0480E-02
CRIT ARRAY       =  1.0000E+12   0.          1.0000E-01   1.0000E+01
```

RADIATION TRANSPORT DATA USED FOR XRAY, NEUTRON, AND GAMMA ENVIRONMENTS (CONVERTED TO LN IF USED)
NOX = 30 NON = 30 NOG = 0

I	TX(I)	RTX(I) GM/CM2	TN(I)	RTN(I) GM/CM2	TG(I)	RTG(I) GM/CM2
1	1.0000E+00	0.	0.	0.	0.	0.
2	9.5000E-01	1.0000E-02	2.6236E-01	1.0000E+00	0.	0.
3	9.2500E-01	2.0000E-02	4.7623E-01	2.0000E+00	0.	0.
4	8.8000E-01	4.0000E-02	6.8310E-01	3.0000E+00	0.	0.
5	8.3500E-01	7.0000E-02	8.5442E-01	4.0000E+00	0.	0.
6	8.0000E-01	1.0000E-01	1.0116E+00	5.0000E+00	0.	0.
7	7.3500E-01	2.0000E-01	1.1314E+00	6.0000E+00	0.	0.
8	6.3000E-01	4.0000E-01	1.3350E+00	8.0000E+00	0.	0.
9	5.8000E-01	7.0000E-01	1.4586E+00	1.0000E+01	0.	0.
10	4.7500E-01	1.0000E+00	1.5476E+00	1.2000E+01	0.	0.
11	4.0000E-01	1.5000E+00	1.6094E+00	1.4000E+01	0.	0.
12	3.4000E-01	2.0000E+00	1.6677E+00	1.6000E+01	0.	0.
13	2.5900E-01	3.0000E+00	1.6901E+00	1.8000E+01	0.	0.
14	2.0000E-01	4.0000E+00	1.6919E+00	2.0000E+01	0.	0.
15	1.6100E-01	5.0000E+00	1.6882E+00	2.2000E+01	0.	0.
16	1.3100E-01	6.0000E+00	1.6620E+00	2.4000E+01	0.	0.
17	8.9000E-02	8.0000E+00	1.6094E+00	2.7000E+01	0.	0.
18	6.2300E-01	1.0000E+01	1.5433E+00	3.0000E+01	0.	0.
19	4.4500E-02	1.2000E+01	1.4110E+00	3.5000E+01	0.	0.
20	3.1000E-02	1.4000E+01	1.2528E+00	4.0000E+01	0.	0.
21	2.0500E-02	1.6000E+01	9.0826E-01	5.0000E+01	0.	0.
22	1.4200E-02	1.8000E+01	5.3063E-01	6.0000E+01	0.	0.
23	9.8000E-03	2.0000E+01	-2.4207E-01	8.0000E+01	0.	0.
24	6.8500E-03	2.2000E+01	-1.0300E+00	1.0000E+02	0.	0.

```
25   4.0700E-03     2.5000E+01    -1.8433E+00     1.2000E+02    0.           0.
26   1.6300E-03     3.0000E+01    -2.6780E+00     1.4000E+02    0.           0.
27   2.9800E-03     4.0000E+01    -3.9581E+00     1.7000E+02    0.           0.
28   5.4000E-05     5.0000E+01    -5.2553E+00     2.0000E+02    0.           0.
29   1.9500E-06     7.0000E+01    -6.5642E+00     2.3000E+02    0.           0.
30   1.6000E-08     1.0000E+02    -7.8833E+00     2.6000E+02    0.           0.


W     =  1.0000E+03      FN    =  2.4100E+23      FG    =  0.
FX    =  7.5000E-01      FT    =  4.1684E-01      DELTG =  0.
FTDG  =  0.              TFACT =  1.0000E+00


TIMAX  =  15.0596  TIMIN  =   0.0000
JINDEX =  1        IHMAX  =  5
JHMAX  =  1        MAXITM =  5
ILOOPS =  1        ITM    =  5    0    0    0


                  LETHAL VOLUME EXTENT FOR ENVIRONMENT NUMBER 1

I    T, SEC      RH, KM       R, KM      RDEL, KM     RUP, KM      RDN, KM      A, KM       PERCNT     NAME
1  1.5060E+01  0.          1.9957E+00  7.0734E-01 -7.0734E-01 -7.0734E-01  2.0262E+00  1.2650E-02  NEUT
2  1.2314E+01  1.3781E+00  1.9486E+00  4.2484E-01 -1.8029E+00  9.5324E-01  1.4082E+00  1.0689E-02  NEUT
3  5.8165E-01  1.8408E+00  1.8408E+00  2.6931E-04 -1.8411E+00  1.8406E+00  3.1026E-02  9.3628E-04  NEUT
4  5.7143E-01  1.8407E+00  1.8407E+00  2.6457E-04 -1.8410E+00  1.8405E+00  3.0480E-02  1.8142E-02  NEUT
5  0.          1.8472E+00  1.8475E+00  0.         -1.8472E+00  1.8472E+00  0.         -1.5986E-02  NEUT
6  0.          0.          0.          0.          0.          0.          0.          0.          NEUT
7  0.          0.          0.          0.          0.          0.          0.          0.          NEUT
       IMAXUP =  3   IMAXDN =  0


TIMAX  =  46.9258  TIMIN  =   0.0000
JINDEX =  1        IHMAX  =  3
JHMAX  =  4        MAXITM =  5
ILOOPS =  2        ITM    =  5    0    0    5
```

LETHAL VOLUME EXTENT FOR ENVIRONMENT NUMBER 4

I	T, SEC	RH, KM	R, KM	RDEL, KM	RUP, KM	RDN, KM	A, KM	PERCNT	NAME
1	4.6926E+01	0.	1.8213E+01	1.3649E+01	-1.3649E+01	-1.3649E+01	1.8243E+01	1.3200E-04	THML
2	3.9649E+01	1.2880E+01	1.8213E+01	8.6973E+00	-2.1578E+01	4.1830E+00	1.2907E+01	3.3508E-04	THML
3	6.7260E-01	1.8213E+01	1.8213E+01	3.1142E-04	-1.8213E+01	1.8213E+01	3.5877E-02	5.6883E-05	THML
4	5.7143E-01	1.8213E+01	1.8213E+01	2.6457E-04	-1.8213E+01	1.8213E+01	3.0480E-02	1.3200E-04	THML
5	0.	1.8213E+01	1.8213E+01	0.	-1.8213E+01	1.8213E+01	0.	1.3200E-04	THML
6	0.	0.	0.	0.	0.	0.	0.	0.	THML
7	0.	0.	0.	0.	0.	0.	0.	0.	THML

IMAXUP = 3 IMAXDN = 0

MAXIMUM DIMENSIONS OF RADIATION LETHAL
VOLUME AND SURFACE EXCLUSION REGION

I	TEX, SEC	AX, KM	RDELEX, KM	REX, KM	RHEX, KM	NAMEH
1	-4.6926E+01	1.8243E+01	1.3649E+01	1.8213E+01	0.	THML
2	-3.9105E+01	1.2550E+01	8.5759E+00	1.8213E+01	1.2955E+01	THML
3	-3.1284E+01	8.0633E+00	6.8307E+00	1.8213E+01	1.4025E+01	THML
4	-2.3463E+01	4.6194E+00	5.0856E+00	1.8213E+01	1.5095E+01	THML
5	-1.5642E+01	2.1682E+00	3.3405E+00	1.8213E+01	1.6165E+01	THML
6	-6.7260E-01	3.5877E-02	3.1142E-04	1.8213E+01	1.8213E+01	THML
7	-0.	0.	0.	1.8213E+01	1.8213E+01	THML

I	RUPEX, KM	NAMEU	RDNEX, KM	NAMED
1	-1.3649E+01	THML	-1.3649E+01	THML
2	-2.1531E+01	THML	4.3790E+00	THML
3	-2.0856E+01	THML	7.1941E+00	THML
4	-2.0180E+01	THML	1.0009E+01	THML
5	-1.9505E+01	THML	1.2824E+01	THML
6	-1.8213E+01	THML	1.8213E+01	THML
7	-1.8213E+01	THML	1.8213E+01	THML

```
OVERALL MAXIMUM CONTOUR EXTENT

   RHMAX (KM)  =  1.8213E+01 FOR THML
   RDNMAX (KM) =  1.8213E+01 FOR THML
   RUPMIN (KM) = -2.1578E+01 FOR THML
```

Output Level 2 - Reduced Radiation Exclusion Region Data

```
STATIC RADIATION FOOTPRINTS

            BOOST PHASE

NEUTRON FOOTPRINT     CRITERIA =   1.00E+12 N/CM**2
      TIME =   1.506E+01 SEC     RADIUS =   1.847E+00 KM
THERMAL FOOTPRINT     CRITERIA =   1.00E+01 CAL/CM**2
      TIME =   4.693E+01 SEC     RADIUS =   2.158E+01 KM
```

Output Level 3 - Combined Static Exclusion Region Data

STATIC CONTOUR PARAMETERS AND LIMITING ENVIRONMENTS

IDATA	TMN, SEC	TMX, SEC	RHMX, KM	RUPMN, KM	RDNMX, KM	NMT1	NMT2	NMRH	NMRU	NMRD
1	-4.6926E+01	-0.	1.8213E+01	-2.1578E+01	1.8213E+01	THML	THML	THML	THML	THML
6	-1.8896E+01	0.	9.3299E+00	-1.2620E+01	6.9288E+00	BLST	BLST	BLST	BLST	BLST

Output Level 1 - AMM Exclusion Region Data Corresponding to Output on File 16. (See Common /BST/ Definitions for Variable Definitions)

BOOSTER DATA AS WRITTEN ON TAPE 16

ID INFORMATION

IFBOOT = BST1
IFMODL = RV A
IFHOB = A

STATIC REGION

FORADI (NMI) = 1.1651012E+01
FOTIMS (SEC) = 4.6925830E+01

BLAST REGION

I	BLATIM(I) SEC	BLADOUT(I) NMI	BLAIN(I) NMI	ANGNEA(I) DEG	ANGFAR(I) DEG
1	0.	6.8144051E+00	0.	1.8000000E+02	1.8000000E+02
2	3.7791331E+00	7.0966288E+00	1.2701489E+00	1.8000000E+02	1.8000000E+02
3	1.1337399E+01	7.4680038E+00	2.9991370E+00	1.8000000E+02	1.8000000E+02
4	1.8895665E+01	7.7562086E+00	4.5030658E+00	1.8000000E+02	1.8000000E+02
5	2.2674798E+01	7.8844629E+00	5.1874675E+00	1.8000000E+02	1.8000000E+02
6	3.0233065E+01	8.1261013E+00	6.7186435E+00	1.8000000E+02	1.8000000E+02
7	3.7791331E+01	8.1937016E+00	8.1937016E+00	1.8000000E+02	1.8000000E+02

DYNAMIC REGION

I	FOTIME(I)	FOLENT(I)	FOWIDT(I)	FOCENT(I)
1	0. MIN	0. NMI	0. NMI	-0. NMI
2	2.9166667E-01	3.0276920E+00	2.5286750E+00	-4.9901703E-01
3	5.8333333E-01	3.7974826E+00	3.3362918E+00	-4.6119081E-01

4	7.3478190E-01	3.5701918E+00	3.2769639E+00	-2.9322785E-01
5	8.8623047E-01	2.6557246E+00	2.5779590E+00	-7.7765642E-02
6	2.6931152E+00	5.2074007E+00	2.2408909E+00	-2.9792108E+00
7	4.5000000E+00	6.9097006E+00	3.1214611E+00	-3.7494499E+00
8	8.0000000E+00	7.3395039E+00	4.5209054E+00	-2.8108738E+00
9	1.1500000E+01	7.9641904E+00	5.2193292E+00	-2.6729132E+00
10	1.5000000E+01	0.	0.	-2.6729132E+00

AMM Booster Flyout Exclusion Data of Output File 16

BST1RV AA

1.1651012E+01	4.6925830E+01	0.	6.8144051E+00	0.	1.8000000E+02
1.8000000E+02	3.7791331E+00	7.0966288E+00	1.2701489E+00	1.8000000E+02	1.8000000E+02
1.1337399E+01	7.4680038E+00	2.9991370E+00	1.8000000E+02	1.8000000E+02	1.8895665E+01
7.7562086E+00	4.5030658E+00	1.8000000E+02	1.8000000E+02	2.2674798E+01	7.8844629E+00
5.1874675E+00	1.8000000E+02	1.8000000E+02	3.0233065E+01	8.1261013E+00	6.7186435E+00
1.8000000E+02	1.8000000E+02	3.7791331E+01	8.1937016E+00	8.1937016E+00	1.8000000E+02
1.8000000E+02	0.	0.	0.	-0.	2.9166667E-01
3.0276920E+00	2.5286750E+00	-4.9901703E-01	5.8333333E-01	3.7974826E+00	3.3362918E+00
-4.6119081E-01	7.3478190E-01	3.5701918E+00	3.2769639E+00	-2.9322785E-01	8.8623047E-01
2.6557246E+00	2.5779590E+00	-7.7765642E-02	2.6931152E+00	5.2074007E+00	2.2408909E+00
-2.9792108E+00	4.5000000E+00	6.9097006E+00	3.1214611E+00	-3.7494499E+00	8.0000000E+00
7.3395039E+00	4.5209054E+00	-2.8108738E+00	1.1500000E+01	7.9641904E+00	5.2193292E+00
-2.6729132E+00	1.5000000E+01	0.	0.	-2.6729132E+00	

AD-A086 223 TRW DEFENSE AND SPACE SYSTEMS GROUP REDONDO BEACH CA F/G 18/3
NUCLEAR WEAPON ENVIRONMENT MODEL. VOLUME II. COMPUTER CODE USER--ETC(U)
FEB 79 R M SAQUI, T A MAZZOLA, J R HOBART DNA001-78-C-0340
UNCLASSIFIED TRW-34001-6006-RU-00 DNA-4868F-2 NL

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Input for Sample Problem 2 - RV Fratricide Exclusion Problem

```
   4RV B     0    3ALL REENTRY ENVIRONMENTS                             CARD 1
    250.       0.        0.                                             CARD 2
      1.       0.                                                       CARD 3
      1.       0.                                                       CARD 4
  1.E+12                                                                CARD 6
  1.E+07                                                                CARD 7
 300000.      24.    24000.      22.9      5.15                         CARD 9
    3.84    15.37       7.5        0.        0.        0.        0.    CARD15-1
      0.       0.                                                       CARD15-2
RV A S      0                                                           CARD17
      0.                                                                CARD19
   1000.       0.   1        0.    1        0.         0.               CARD21
```

RV fratricide Exclusion Problem Output

```
———————————————————— Output Level 1 - Input Echo:  RV and Problem Identifiers ————
ALL REENTRY ENVIRONMENTS
THIS IS AN RV FOOTPRINT FOR RV RV B

———————————————————— Output Level 1 - Input Echo:  Vulnerability Criteria ————
BLAST VULNERABILITY CRITERIA DATA
    TOTAL ACCELERATION     2.50000E+02 G'S
    AXIAL ACCELERATION     0.          G'S
    NORMAL ACCELERATION    0.          G'S

DUST VULNERABILITY CRITERIA DATA
    INTERCEPTED KINETIC ENERGY    1.00000E+00 KJ/CM**2
    CLOUD CUT-OFF TIME INPUT      0.          MIN
    CLOUD CUT-OFF TIME USED       2.50000E+01 MIN

PEBBLE/EJECTA VULNERABILTY CRITERIA DATA
    CRITICAL PARTICLE DIAMETER    1.00000E+00 CM
    CRITICAL HIT DENSITY          0.          NO/CM**2
*** REGARDLESS OF INPUT ONLY AVOIDANCE WILL BE USED ***

NEUTRON VULNERABILITY CRITERIA DATA
    NEUTRON FLUENCE    1.00000E+12 N/CM**2

GAMMA RAY VULNERABILITY CRITERIA DATA
    PEAK GAMMA DOSE RATE    1.00000E+07 RAD(SI)/SEC
———————————————————— Output Level 1 - Input Echo:  RV Parameters for Trajectory ————

RV PARAMETERS FOR TRAJECTORY CALCULATION
    REENTRY HEIGHT           3.00000E+05 FT
    REENTRY ANGLE            2.40000E+01 DEG
    REENTRY VELOCITY         2.40000E+04 FT/SEC
    RV MASS                  2.29000E+01 SLUGS
    RV REFERENCE AREA        5.15000E+00 FT**2
    RV NOSE RADIUS           3.84000E+00 IN
    RV BASE RADIUS           1.53700E+01 IN
    RV CONE HALF ANGLE       7.50000E+00 DEG
    RV SURFACE ROUGHNESS     0.          IN
```

RV CYLINDER HALF ANGLE	0.	DEG
RV FLARE HALF ANGLE	0.	DEG
RV CONE LENGTH	0.	IN
RV CYLINDER LENGTH	0.	IN
RV FLARE LENGTH	0.	IN

*** RVCYHA, RVFHA, RVCL, RVCYL AND RVFL ARE NOT PRESENTLY USED ***

Output Level 2 - Expanded Input Echo: Drag Force Coefficients

17 MACH NUMBERS
10 ANGLES OF ATTACK

NORMAL DRAG COEFFICIENT

ANGLE DEG	MACH NUMBER 4.00000E-01	6.00000E-01	8.00000E-01	9.00000E-01	1.00000E+00	1.20000E+00	1.50000E+00
0.	0.	0.	0.	0.	0.	0.	0.
5.00000E+00	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01
1.00000E+01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01
1.50000E+01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01
2.00000E+01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01
2.50000E+01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01
3.00000E+01	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00
3.50000E+01	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00
4.00000E+01	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00
4.50000E+01	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00

ANGLE DEG	MACH NUMBER 2.00000E+00	2.50000E+00	3.00000E+00	4.00000E+00	5.00000E+00	6.00000E+00	8.00000E+00
0.	0.	0.	0.	0.	0.	0.	0.
5.00000E+00	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01	1.53872E-01
1.00000E+01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01	3.06033E-01
1.50000E+01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01	4.79553E-01
2.00000E+01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01	6.80188E-01
2.50000E+01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01	9.02876E-01
3.00000E+01	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00	1.14109E+00

3.50000E+01	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00	1.38767E+00
4.00000E+01	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00	1.63517E+00
4.50000E+01	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00	1.87608E+00

ANGLE	MACH NUMBER		
DEG	1.00000E+01	1.50000E+01	2.00000E+01
0.	0.	0.	0.
5.00000E+00	1.53872E-01	1.53872E-01	1.53872E-01
1.00000E+01	3.06033E-01	3.06033E-01	3.06033E-01
1.50000E+01	4.79553E-01	4.79553E-01	4.79553E-01
2.00000E+01	6.80188E-01	6.80188E-01	6.80188E-01
2.50000E+01	9.02876E-01	9.02876E-01	9.02876E-01
3.00000E+01	1.14109E+00	1.14109E+00	1.14109E+00
3.50000E+01	1.38767E+00	1.38767E+00	1.38767E+00
4.00000E+01	1.63517E+00	1.63517E+00	1.63517E+00
4.50000E+01	1.87608E+00	1.87608E+00	1.87608E+00

AXIAL DRAG COEFFICIENT

ANGLE	MACH NUMBER						
DEG	4.00000E-01	6.00000E-01	8.00000E-01	9.00000E-01	1.00000E+00	1.20000E+00	1.50000E+00
0.	1.61081E-02	2.58440E-02	4.75024E-02	6.62512E-02	8.86403E-02	1.08443E-01	1.11729E-01
5.00000E+00	1.72209E-02	2.76294E-02	5.07842E-02	7.08283E-02	9.47642E-02	1.15934E-01	1.19448E-01
1.00000E+01	2.04513E-02	3.28123E-02	6.03106E-02	8.41147E-02	1.12541E-01	1.37682E-01	1.41855E-01
1.50000E+01	2.49690E-02	4.00606E-02	7.36334E-02	1.02696E-01	1.37401E-01	1.68096E-01	1.73191E-01
2.00000E+01	3.02951E-02	4.86059E-02	8.93400E-02	1.24602E-01	1.66710E-01	2.03953E-01	2.10134E-01
2.50000E+01	3.62152E-02	5.81042E-02	1.06798E-01	1.48951E-01	1.99287E-01	2.43808E-01	2.51198E-01
3.00000E+01	4.25324E-02	6.82396E-02	1.25428E-01	1.74933E-01	2.34050E-01	2.86337E-01	2.95015E-01
3.50000E+01	4.90473E-02	7.86921E-02	1.44640E-01	2.01728E-01	2.69901E-01	3.30196E-01	3.40204E-01
4.00000E+01	5.55580E-02	8.91380E-02	1.63840E-01	2.28506E-01	3.05728E-01	3.74027E-01	3.85364E-01
4.50000E+01	6.18644E-02	9.92559E-02	1.82437E-01	2.54444E-01	3.40431E-01	4.16483E-01	4.29106E-01

ANGLE	MACH NUMBER						
DEG	2.00000E+00	2.50000E+00	3.00000E+00	4.00000E+00	5.00000E+00	6.00000E+00	8.00000E+00

0.	1.12254E-01	1.03656E-01	9.84825E-02	9.58326E-02	9.23505E-02	8.98859E-02	8.68241E-02
5.00000E+00	1.20010E-01	1.10818E-01	1.05286E-01	1.02453E-01	9.87307E-02	9.60958E-02	9.28225E-02
1.00000E+01	1.42522E-01	1.31605E-01	1.25037E-01	1.21672E-01	1.17251E-01	1.14122E-01	1.10235E-01
1.50000E+01	1.74005E-01	1.60677E-01	1.52658E-01	1.48550E-01	1.43152E-01	1.39332E-01	1.34586E-01
2.00000E+01	2.11122E-01	1.94951E-01	1.85221E-01	1.80237E-01	1.73688E-01	1.69052E-01	1.63294E-01
2.50000E+01	2.52378E-01	2.33047E-01	2.21415E-01	2.15458E-01	2.07629E-01	2.02088E-01	1.95204E-01
3.00000E+01	2.96402E-01	2.73699E-01	2.60038E-01	2.53041E-01	2.43847E-01	2.37339E-01	2.29254E-01
3.50000E+01	3.41803E-01	3.15623E-01	2.99869E-01	2.91800E-01	2.81198E-01	2.73693E-01	2.64370E-01
4.00000E+01	3.87175E-01	3.57519E-01	3.39675E-01	3.30535E-01	3.18525E-01	3.10024E-01	2.99464E-01
4.50000E+01	4.31123E-01	3.98101E-01	3.78231E-01	3.68053E-01	3.54680E-01	3.45214E-01	3.33456E-01

ANGLE	MACH NUMBER		
DEG	1.00000E+01	1.50000E+01	2.00000E+01
0.	8.53095E-02	8.48283E-02	8.53695E-02
5.00000E+00	9.12033E-02	9.06888E-02	9.12674E-02
1.00000E+01	1.08312E-01	1.07701E-01	1.08388E-01
1.50000E+01	1.32238E-01	1.31492E-01	1.32331E-01
2.00000E+01	1.60446E-01	1.59540E-01	1.60558E-01
2.50000E+01	1.91799E-01	1.90717E-01	1.91934E-01
3.00000E+01	2.25255E-01	2.23985E-01	2.25414E-01
3.50000E+01	2.59759E-01	2.58293E-01	2.59941E-01
4.00000E+01	2.94240E-01	2.92580E-01	2.94447E-01
4.50000E+01	3.27639E-01	3.25790E-01	3.27869E-01

75 TRAJECTORY POINTS

TIME SEC	ALTITUDE FT	RANGE NMI	VELOCITY FT/SEC	ANGLE DEG
0.	0.	0.	2.93136E+03	2.68468E+01
7.96654E-01	1.13757E+03	3.69619E-01	3.38536E+03	2.64410E+01
1.52114E+00	2.30927E+03	7.56307E-01	3.85687E+03	2.61198E+01
2.18676E+00	3.51613E+03	1.15972E+00	4.34567E+03	2.58602E+01
2.80547E+00	4.75918E+03	1.58085E+00	4.84519E+03	2.56453E+01
3.38483E+00	6.03953E+03	2.01931E+00	5.35867E+03	2.54647E+01

3.92933E+00	7.35829E+03	2.47423E+00	5.88971E+03	2.53120E+01
4.44395E+00	8.71661E+03	2.94580E+00	6.43267E+03	2.51814E+01
4.93278E+00	1.01157E+04	3.43416E+00	6.98874E+03	2.50687E+01
5.39918E+00	1.15567E+04	3.93964E+00	7.55886E+03	2.49707E+01
5.84568E+00	1.30410E+04	4.46234E+00	8.14360E+03	2.48850E+01
6.27464E+00	1.45698E+04	5.00273E+00	8.74323E+03	2.48096E+01
6.68785E+00	1.61445E+04	5.56098E+00	9.35769E+03	2.47430E+01
7.08718E+00	1.77664E+04	6.13780E+00	9.98668E+03	2.46840E+01
7.47382E+00	1.94369E+04	6.73327E+00	1.06295E+04	2.46315E+01
7.84921E+00	2.11576E+04	7.34802E+00	1.12853E+04	2.45848E+01
8.21451E+00	2.29299E+04	7.98256E+00	1.19529E+04	2.45431E+01
8.57063E+00	2.47554E+04	8.63715E+00	1.26305E+04	2.45058E+01
8.91870E+00	2.66356E+04	9.31257E+00	1.33163E+04	2.44724E+01
9.25959E+00	2.85723E+04	1.00093E+01	1.40077E+04	2.44425E+01
9.59417E+00	3.05670E+04	1.07279E+01	1.47022E+04	2.44157E+01
9.92317E+00	3.26216E+04	1.14688E+01	1.53964E+04	2.43917E+01
1.02475E+01	3.47378E+04	1.22329E+01	1.60871E+04	2.43702E+01
1.05679E+01	3.69175E+04	1.30207E+01	1.67709E+04	2.43509E+01
1.08851E+01	3.91626E+04	1.38330E+01	1.74339E+04	2.43335E+01
1.12003E+01	4.14751E+04	1.46703E+01	1.80692E+04	2.43179E+01
1.15141E+01	4.38569E+04	1.55335E+01	1.86741E+04	2.43039E+01
1.18276E+01	4.63102E+04	1.64233E+01	1.92465E+04	2.42912E+01
1.21415E+01	4.88371E+04	1.73405E+01	1.97847E+04	2.42797E+01
1.24567E+01	5.14398E+04	1.82857E+01	2.02876E+04	2.42692E+01
1.27739E+01	5.41205E+04	1.92599E+01	2.07545E+04	2.42597E+01
1.30937E+01	5.68817E+04	2.02638E+01	2.11851E+04	2.42510E+01
1.34169E+01	5.97257E+04	2.12983E+01	2.15799E+04	2.42430E+01
1.37443E+01	6.26551E+04	2.23642E+01	2.19379E+04	2.42357E+01
1.40765E+01	6.56723E+04	2.34627E+01	2.22588E+04	2.42290E+01
1.44140E+01	6.87800E+04	2.45940E+01	2.25447E+04	2.42227E+01
1.47575E+01	7.19810E+04	2.57589E+01	2.27956E+04	2.42169E+01
1.51078E+01	7.52780E+04	2.69593E+01	2.30169E+04	2.42115E+01
1.54654E+01	7.86739E+04	2.81954E+01	2.32081E+04	2.42063E+01
1.58309E+01	8.21717E+04	2.94685E+01	2.33715E+04	2.42014E+01
1.62051E+01	8.57745E+04	3.07801E+01	2.35111E+04	2.41968E+01
1.65886E+01	8.94853E+04	3.21315E+01	2.36295E+04	2.41922E+01

1.69820E+01	9.33074E+04	3.35241E+01	2.37301E+04	2.41878E+01
1.73857E+01	9.72442E+04	3.49585E+01	2.38138E+04	2.41834E+01
1.78005E+01	1.01299E+05	3.64366E+01	2.38836E+04	2.41791E+01
1.82267E+01	1.05476E+05	3.79591E+01	2.39416E+04	2.41748E+01
1.86648E+01	1.09777E+05	3.95274E+01	2.39894E+04	2.41706E+01
1.91153E+01	1.14208E+05	4.11431E+01	2.40286E+04	2.41663E+01
1.95789E+01	1.18772E+05	4.28074E+01	2.40603E+04	2.41619E+01
2.00559E+01	1.23473E+05	4.45217E+01	2.40855E+04	2.41576E+01
2.05468E+01	1.28315E+05	4.62875E+01	2.41051E+04	2.41531E+01
2.10523E+01	1.33302E+05	4.81063E+01	2.41201E+04	2.41486E+01
2.15727E+01	1.38438E+05	4.99797E+01	2.41311E+04	2.41440E+01
2.21087E+01	1.43729E+05	5.19093E+01	2.41388E+04	2.41393E+01
2.26607E+01	1.49179E+05	5.38968E+01	2.41438E+04	2.41345E+01
2.32293E+01	1.54791E+05	5.59439E+01	2.41464E+04	2.41295E+01
2.38150E+01	1.60573E+05	5.80524E+01	2.41471E+04	2.41244E+01
2.44185E+01	1.66528E+05	6.02240E+01	2.41461E+04	2.41192E+01
2.50402E+01	1.72661E+05	6.24608E+01	2.41437E+04	2.41138E+01
2.56808E+01	1.78978E+05	6.47646E+01	2.41401E+04	2.41083E+01
2.63409E+01	1.85485E+05	6.71374E+01	2.41355E+04	2.41026E+01
2.70211E+01	1.92187E+05	6.95814E+01	2.41298E+04	2.40967E+01
2.77221E+01	1.99091E+05	7.20985E+01	2.41233E+04	2.40906E+01
2.84445E+01	2.06201E+05	7.46911E+01	2.41160E+04	2.40843E+01
2.91889E+01	2.13524E+05	7.73614E+01	2.41081E+04	2.40779E+01
2.99562E+01	2.21068E+05	8.01116E+01	2.40995E+04	2.40712E+01
3.07469E+01	2.28837E+05	8.29442E+01	2.40903E+04	2.40643E+01
3.15620E+01	2.36840E+05	8.58617E+01	2.40806E+04	2.40572E+01
3.24021E+01	2.45083E+05	8.88666E+01	2.40704E+04	2.40498E+01
3.32680E+01	2.53573E+05	9.19615E+01	2.40597E+04	2.40422E+01
3.41605E+01	2.62318E+05	9.51491E+01	2.40486E+04	2.40343E+01
3.50806E+01	2.71325E+05	9.84322E+01	2.40371E+04	2.40262E+01
3.60290E+01	2.80602E+05	1.01814E+02	2.40251E+04	2.40177E+01
3.70068E+01	2.90158E+05	1.05296E+02	2.40128E+04	2.40090E+01
3.80147E+01	3.00000E+05	1.08883E+02	2.40000E+04	2.40000E+01

Output Level 1 - Input Echo: Detonating RV Identifier

RV RV A WITH A HEIGHT OF BURST OPTION S

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------------------------------------------- Output Level 1 - Input Echo:  Yield and Burst Altitude ----------
BURST HEIGHT     0.          FT
BURST YIELD      1.00000E+03 KT
------------------------------------------- Output Level 1 - Input Echo:  Neutron Characteristics ----------
NEUTRON OUTPUT INPUT     0.          N/KT
NEUTRON OUTPUT USED      2.41000E+23 N/KT

STORED NEUTRON TRANSMISSION DATA USED
    SET NUMBER       1
------------------------------------------- Output Level 2 - Expanded Input Echo:  Neutron Transmission Data -
      30  DATA POINTS

    AIR MASS (G/CM**2)
      0.           1.00000E+00  2.00000E+00  3.00000E+00  4.00000E+00  5.00000E+00  6.00000E+00  8.00000E+00
      1.00000E+01  1.20000E+01  1.40000E+01  1.60000E+01  1.80000E+01  2.00000E+01  2.20000E+01  2.40000E+01
      2.70000E+01  3.00000E+01  3.50000E+01  4.00000E+01  5.00000E+01  6.00000E+01  8.00000E+01  1.00000E+02
      1.20000E+02  1.40000E+02  1.70000E+02  2.00000E+02  2.30000E+02  2.60000E+02

    NORMALIZED NEUTRON FLUENCE
      1.00000E+00  1.30000E+00  1.61000E+00  1.98000E+00  2.35000E+00  2.75000E+00  3.10000E+00  3.80000E+00
      4.30000E+00  4.70000E+00  5.00000E+00  5.30000E+00  5.42000E+00  5.43000E+00  5.41000E+00  5.27000E+00
      5.00000E+00  4.68000E+00  4.10000E+00  3.50000E+00  2.48000E+00  1.70000E+00  7.85000E-01  3.57000E-01
      1.58300E-01  6.87000E-02  1.91000E-02  5.22000E-03  1.41000E-03  3.77000E-04
------------------------------------------- Output Level 1 - Input Echo:  Gamma ray Characteristics ----------
GAMMA RAY ENERGY FRACTION INPUT            0.
GAMMA RAY PULSE WIDTH INPUT                0.            NS
GAMMA RAY DOSE CONVERSION FACTOR INPUT     0.            RAD(SI)*CM**2/CAL
GAMMA RAY DOSE CONVERSION FACTOR USED      1.30000E+04   RAD(SI)*CM**2/CAL

STORED GAMMA RAY TRANSMISSION DATA USED
    SET NUMBER       1
------------------------------------------- Output Level 2 - Expanded Input Echo:  Gamma ray Transmission Data
      30  DATA POINTS

    AIR MASS (G/CM**2)
```

0.	1.00000E+00	2.00000E+00	3.00000E+00	4.00000E+00	5.00000E+00	6.00000E+00	8.00000E+00
1.00000E+01	1.20000E+01	1.40000E+01	1.60000E+01	1.80000E+01	2.00000E+01	2.20000E+01	2.40000E+01
2.70000E+01	3.00000E+01	3.50000E+01	4.00000E+01	5.00000E+01	6.00000E+01	8.00000E+01	1.00000E+02
1.20000E+02	1.40000E+02	1.70000E+02	2.00000E+02	2.30000E+02	2.60000E+02		

NORMALIZED GAMMA RAY PEAK DOSE RATE

1.00000E+00	9.33400E-01	8.72600E-01	8.16800E-01	7.65700E-01	7.18700E-01	6.75400E-01	5.98500E-01
5.32600E-01	4.75900E-01	4.26600E-01	3.83600E-01	3.45800E-01	3.12600E-01	2.83100E-01	2.57000E-01
2.22900E-01	1.94000E-01	1.54900E-01	1.24400E-01	8.16200E-02	5.44300E-02	2.51500E-02	1.21000E-02
6.00800E-03	3.06400E-03	1.16200E-03	4.58500E-04	1.87000E-04	7.84300E-05		

Output Level 3 - Initial Expanded Blast Output Data

YDI = 1.00 ZI = 0.000 Z2 = 0.000 ZO = 0.000
T = 0.000 IV = 4
TSTAR = 0.000 YSTAR = 0.000

TIME = 0.00

Y	X	AREA	MECH

NO FOOTPRINT

Output Level 3 - Detailed Blast Exclusion Region Data

TIME = .63

	Y	X	AREA	MECH
*	3.325	0.000	0.00	4
*	3.542	.756	-.16	4
*	3.345	1.512	.28	4
*	3.021	2.268	1.51	4
*	2.904	2.385	2.05	4
*	2.673	2.646	3.21	4
*	2.526	2.793	4.01	4
*	2.312	3.024	5.26	4
*	2.148	3.188	6.28	4
*	1.935	3.402	7.68	4
*	1.770	3.567	8.83	4
*	1.014	3.610	14.25	4
*	.258	3.963	19.98	4
*	-.498	3.950	25.96	4
*	-.668	3.780	27.28	4
*	-.876	3.632	28.82	4
*	-1.631	3.553	34.25	4
*	-2.208	3.024	38.04	4

*	-2.765	2.669	41.21	4
*	-2.988	2.268	42.31	4
*	-3.483	1.512	44.18	4
*	-3.521	1.387	44.29	4
*	-3.661	1.134	44.65	4
*	-3.787	.378	44.84	4
*	-3.797	0.000	44.84	4

Output level 3 - Simplified Blast Exclusion Region Data

DU = -3.5418, DC = 3.9630, DD = 3.7972, AREA = 44.8407
LENGTH = 3.6695 CENTER = .1277 WIDTH = 3.9630

TIME = 1.26

	Y	X	AREA	MECH
*	-.654	0.000	0.00	4
*	-.616	.080	-.00	4
*	-.361	.378	-.12	4
*	-.238	.467	-.22	4
*	.352	.756	-.94	4
*	.518	.858	-1.21	4
*	.961	1.134	-2.10	4
*	1.274	1.454	-2.91	4
*	1.332	1.512	-3.08	4
*	1.652	2.032	-4.21	4
*	1.756	2.268	-4.66	4
*	1.792	3.024	-4.85	4
*	1.652	3.482	-3.94	4
*	1.484	3.780	-2.72	4
*	1.274	3.998	-1.08	4
*	1.089	4.158	.42	4
*	.896	4.284	2.05	4
*	.335	4.536	7.00	4
*	.140	4.593	8.78	4

*	-.616	4.680	15.79	4
*	-1.372	4.610	22.81	4
*	-2.128	4.410	29.63	4
*	-2.679	4.158	34.36	4
*	-2.884	4.067	36.04	4
*	-3.326	3.780	39.51	4
*	-3.640	3.560	41.81	4
*	-3.809	3.402	42.99	4
*	-4.018	3.231	44.37	4
*	-4.134	3.024	45.10	4
*	-4.396	2.759	46.61	4
*	-4.508	2.646	47.22	4
*	-4.774	2.314	48.54	4
*	-4.820	2.268	48.75	4
*	-5.152	1.583	50.03	4
*	-5.222	1.512	50.25	4
*	-5.403	.756	50.66	4
*	-5.504	0.000	50.73	4

DU = -1.7922, DC = 4.6799, DD = 5.5038, AREA = 50.7334
LENGTH = 3.6480 CENTER = 1.8558 WIDTH = 4.6799

TIME = 1.89

	Y	X	AREA	MECH
*	-1.873	0.000	0.00	4
*	-1.610	.731	-.19	4
*	-1.592	.756	-.22	4
*	-1.232	1.234	-.94	4
*	-.996	1.512	-1.58	4
*	-.854	1.745	-2.05	4
*	-.746	1.890	-2.44	4
*	-.476	2.440	-3.61	4

*	-.396	2.646	-4.01	4
*	-.420	3.402	-3.87	4
*	-.476	3.535	-3.48	4
*	-.577	3.780	-2.74	4
*	-.854	4.112	-.56	4
*	-.902	4.158	-.16	4
*	-1.232	4.363	2.65	4
*	-1.711	4.536	6.91	4
*	-1.988	4.590	9.44	4
*	-2.744	4.614	16.40	4
*	-3.222	4.536	20.78	4
*	-3.499	4.476	23.28	4
*	-4.255	4.199	29.83	4
*	-4.988	3.780	35.68	4
*	-5.389	3.483	38.59	4
*	-5.837	3.024	41.51	4
*	-6.476	2.268	44.89	4
*	-6.523	2.204	45.10	4
*	-6.671	1.890	45.70	4
*	-6.901	1.453	46.48	4
*	-7.034	1.134	46.82	4
*	-7.114	.378	46.94	4
*	-7.122	0.000	46.94	4

DU = .3960, DC = 4.6141, DD = 7.1217, AREA = 46.9425
LENGTH = 3.3628 CENTER = 3.7589 WIDTH = 4.6141

TIME = 2.52

	Y	X	AREA	MECH
*	-3.522	0.000	0.00	4
*	-3.420	.718	-.07	4
*	-3.410	.756	-.09	4

*	-3.130	1.512	-.72	4
*	-2.843	2.268	-1.81	4
*	-2.728	3.024	-2.42	4
*	-3.036	3.780	-.32	4
*	-3.420	4.120	2.71	4
*	-4.176	4.353	9.12	4
*	-4.932	4.336	15.69	4
*	-5.630	4.158	21.62	4
*	-5.688	4.142	22.09	4
*	-6.444	3.787	28.09	4
*	-6.995	3.402	32.05	4
*	-7.578	2.878	35.71	4
*	-8.020	2.268	37.99	4
*	-8.432	1.512	39.54	4
*	-8.701	.756	40.16	4
*	-8.790	0.000	40.22	4

DU = 2.7275, DC = 4.3526, DD = 8.7899, AREA = 40.2226
LENGTH = 3.0312 CENTER = 5.7587 WIDTH = 4.3526

TIME = 3.15

	Y	X	AREA	MECH
*	-5.586	0.000	0.00	4
*	-5.539	.756	-.04	4
*	-5.437	1.512	-.27	4
*	-5.373	1.933	-.48	4
*	-5.339	2.268	-.63	4
*	-5.455	3.024	-.02	4
*	-5.751	3.422	1.89	4
*	-6.507	3.760	7.32	4
*	-7.263	3.747	13.00	4
*	-8.019	3.493	18.47	4

*	-8.178	3.402	19.57	4
*	-8.397	3.283	21.03	4
*	-8.762	3.024	23.33	4
*	-8.775	3.015	23.41	4
*	-9.169	2.646	25.64	4
*	-9.531	2.213	27.40	4
*	-9.717	1.890	28.16	4
*	-9.909	1.567	28.83	4
*	-9.921	1.512	28.86	4
*	-10.162	.756	29.41	4
*	-10.260	0.000	29.49	4

DU = 5.3394, DC = 3.7600, DD = 10.2604, AREA = 29.4861
LENGTH = 2.4605 CENTER = 7.7999 WIDTH = 3.7600

TIME = 3.78

	Y	X	AREA	MECH
*	-8.231	0.000	0.00	4
*	-8.242	.756	.01	4
*	-8.314	1.512	.17	4
*	-8.647	2.268	1.43	4
*	-8.741	2.355	1.86	4
*	-9.497	2.551	5.57	4
*	-10.253	2.278	9.22	4
*	-10.714	1.890	11.14	4
*	-11.215	1.134	12.66	4
*	-11.387	.720	12.98	4
*	-11.441	.378	13.04	4
*	-11.463	0.000	13.05	4

DU = 8.2312, DC = 2.5506, DD = 11.4632, AREA = 13.0461

LENGTH = 1.6160 CENTER = 9.8472 WIDTH = 2.5506

TIME = 4.41

Y X AREA MECH

NO FOOTPRINT

Output Level 2 - Reduced Blast Exclusion Region Data

BLAST FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 0.
3 FAILURE CRITERIA = 2.50E+02, 1.00E+70, 1.00E+70

FOOTPRINT TIME HISTORY

	RECTANGLE			CIRCLE OR ANNULUS			
T (SEC)	LENGTH (KFT)	WIDTH DR (KFT)	OFFSET (KFT)	RMAX (KFT)	RMIN (KFT)	PHI1 (DEG)	PHI2 (DEG)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
.630	3.670	3.963	.128	0.000	0.000	0.000	0.000
1.260	3.648	4.680	1.856	0.000	0.000	0.000	0.000
1.890	3.363	4.614	3.759	0.000	0.000	0.000	0.000
2.520	3.031	4.353	5.759	0.000	0.000	0.000	0.000
3.150	2.461	3.760	7.800	0.000	0.000	0.000	0.000
3.780	1.616	2.551	9.847	0.000	0.000	0.000	0.000
4.410	0.000	0.000	9.847	0.000	0.000	0.000	0.000

Output Level 2 - Reduced Ejecta Exclusion Region Data

EJECTA FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 0.
CRITICAL DIAMETER = 1.000E+00 CRITICAL DENSITY = 0.

FOOTPRINT TIME HISTORY

T (SEC)	LENGTH (KFT)	WIDTH (KFT)	DR OFFSET (KFT)
0.000	0.000	0.000	0.000
5.000	16.437	8.119	8.319
10.000	22.594	11.428	11.166
15.000	27.383	14.223	13.160
20.000	30.791	16.506	14.285
25.000	32.813	18.274	14.539
30.000	33.599	19.530	14.069
35.000	33.218	20.272	12.946
40.000	31.675	20.499	11.176
45.000	28.549	19.780	8.769
50.000	23.513	17.765	5.748
55.000	16.623	14.455	2.168
60.000	0.000	0.000	0.000

Output Level 2 - Reduced Pebble/Dust Exclusion Region Data

DUST FOOTPRINT SUMMARY

BURST YIELD = 1.00E+00 BURST HEIGHT = 0.
INTERCEPTED KE = 6.85E+05 CLOUD CUTOFF = 1.50E+03

FOOTPRINT TIME HISTORY

T (SEC)	LENGTH (KFT)	WIDTH (KFT)	DR OFFSET (KFT)
0.000	0.000	0.000	0.000
30.000	16.741	4.610	15.603
60.000	28.511	7.202	27.114
90.000	40.793	9.350	39.581
120.000	51.503	11.253	49.974
150.000	60.345	12.991	58.552
180.000	67.310	14.609	65.311
210.000	73.118	16.133	70.967
240.000	76.371	17.581	74.125
270.000	77.745	18.966	75.459
300.000	75.813	20.297	72.133
330.000	72.946	21.582	69.370
360.000	71.357	22.825	67.860
390.000	70.888	24.032	66.071
420.000	70.068	25.207	65.306
450.000	69.533	26.352	64.808
480.000	69.908	27.469	63.859
510.000	69.816	28.563	63.774
540.000	70.580	29.633	63.186
570.000	70.843	30.683	63.422
600.000	71.947	31.713	63.123
630.000	72.626	31.713	62.445
660.000	73.305	31.713	61.766
690.000	73.305	31.713	61.766
720.000	73.983	31.713	61.087
750.000	74.662	31.713	60.408

780.000	75.341	31.713	59.730
810.000	76.020	31.713	59.051
840.000	76.020	31.713	59.051
870.000	76.698	31.713	58.372
900.000	0.000	0.000	58.372

DETAILED PROGRAM OUTPUT EDIT FOLLOWS

```
BURST YIELD (KT) =  1.0000E+03
IPHASE           =  4
ALTITUDE (KM)    =  0.
CRIT ARRAY       =  1.0000E+12   1.0000E+07   0.          0.
```

RADIATION TRANSPORT DATA USED FOR XRAY, NEUTRON, AND GAMMA ENVIRONMENTS (CONVERTED TO LN IF USED)
NOX = 0 NON = 30 NOG = 30

I	TX(I)	RTX(I) GM/CM2	TN(I)	RTN(I) GM/CM2	TG(I)	RTG(I) GM/CM2
1	0.	0.	0.	0.	0.	0.
2	0.	0.	2.6236E-01	1.0000E+00	-6.8921E-02	1.0000E+00
3	0.	0.	4.7623E-01	2.0000E+00	-1.3628E-01	2.0000E+00
4	0.	0.	6.8310E-01	3.0000E+00	-2.0236E-01	3.0000E+00
5	0.	0.	8.5442E-01	4.0000E+00	-2.6696E-01	4.0000E+00
6	0.	0.	1.0116E+00	5.0000E+00	-3.3031E-01	5.0000E+00
7	0.	0.	1.1314E+00	6.0000E+00	-3.9245E-01	6.0000E+00
8	0.	0.	1.3350E+00	8.0000E+00	-5.1333E-01	8.0000E+00
9	0.	0.	1.4586E+00	1.0000E+01	-6.2998E-01	1.0000E+01
10	0.	0.	1.5476E+00	1.2000E+01	-7.4255E-01	1.2000E+01
11	0.	0.	1.6094E+00	1.4000E+01	-8.5191E-01	1.4000E+01
12	0.	0.	1.6677E+00	1.6000E+01	-9.5815E-01	1.6000E+01
13	0.	0.	1.6901E+00	1.8000E+01	-1.0619E+00	1.8000E+01
14	0.	0.	1.6919E+00	2.0000E+01	-1.1628E+00	2.0000E+01
15	0.	0.	1.6882E+00	2.2000E+01	-1.2620E+00	2.2000E+01
16	0.	0.	1.6620E+00	2.4000E+01	-1.3587E+00	2.4000E+01
17	0.	0.	1.6094E+00	2.7000E+01	-1.5010E+00	2.7000E+01
18	0.	0.	1.5433E+00	3.0000E+01	-1.6399E+00	3.0000E+01
19	0.	0.	1.4110E+00	3.5000E+01	-1.8650E+00	3.5000E+01
20	0.	0.	1.2528E+00	4.0000E+01	-2.0843E+00	4.0000E+01
21	0.	0.	9.0826E-01	5.0000E+01	-2.5057E+00	5.0000E+01
22	0.	0.	5.3063E-01	6.0000E+01	-2.9108E+00	6.0000E+01
23	0.	0.	-2.4207E-01	8.0000E+01	-3.6829E+00	8.0000E+01
24	0.	0.	-1.0300E+00	1.0000E+02	-4.4145E+00	1.0000E+02

25	0.	0.	-1.8433E+00	1.2000E+02	-5.1147E+00	1.2000E+02
26	0.	0.	-2.6780E+00	1.4000E+02	-5.7880E+00	1.4000E+02
27	0.	0.	-3.9581E+00	1.7000E+02	-6.7576E+00	1.7000E+02
28	0.	0.	-5.2553E+00	2.0000E+02	-7.6876E+00	2.0000E+02
29	0.	0.	-6.5642E+00	2.3000E+02	-6.5844E+00	2.3000E+02
30	0.	0.	-7.8833E+00	2.6000E+02	-9.4533E+00	2.6000E+02

```
W      =  1.0000E+03     FN     =  2.4100E+23     FG    =  3.0000E-03
FX     =  0.             FT     =  0.             DELTG =  2.0000E-08
FTDG   =  1.3000E+04     TFACT  =  0.

TIMAX  =   3.5871   TIMIN  =   0.0000
JINDEX =  1         IHMAX  =  4
JHMAX  =  1         MAXITM =  4
ILOOPS =  1         ITM    =  4    0    0    0
```

LETHAL VOLUME EXTENT FOR ENVIRONMENT NUMBER 1

I	T, SEC	RH, KM	R, KM	RDEL, KM	RUP, KM	RDN, KM	A, KM	PERCNT	NAME
1	3.5871E+00	0.	1.9902E+00	4.0528E+00	4.0528E+00	4.0528E+00	1.9902E+00	6.0237E-03	NEUT
2	3.2947E+00	8.4882E-01	1.9722E+00	3.6135E+00	2.7647E+00	4.4623E+00	1.7802E+00	-7.5619E-04	NEUT
3	9.2915E-01	1.8215E+00	1.8675E+00	8.1551E-01	-1.0060E+00	2.6370E+00	4.1205E-01	-8.6137E-04	NEUT
4	0.	1.8363E+00	1.8363E+00	0.	-1.8363E+00	1.8363E+00	0.	1.7182E-03	NEUT
5	0.	0.	0.	0.	0.	0.	0.	0.	NEUT
6	0.	0.	0.	0.	0.	0.	0.	0.	NEUT
7	0.	0.	0.	0.	0.	0.	0.	0.	NEUT

IMAXUP = 2 IMAXDN = 0

```
TIMAX  =   5.1489   TIMIN  =   0.0000
JINDEX =  1         IHMAX  =  3
JHMAX  =  2         MAXITM =  4
ILOOPS =  2         ITM    =  4    4    0    0
```

LETHAL VOLUME EXTENT FOR ENVIRONMENT NUMBER 2

I	T, SEC	RH, KM	R, KM	RDEL, KM	RUP, KM	RDN, KM	A, KM	PERCNT	NAME
1	5.1489E+00	0.	3.2868E+00	6.7938E+00	6.7938E+00	6.7938E+00	3.2868E+00	8.3326E-04	PGAM
2	4.7617E+00	1.3749E+00	3.2402E+00	6.0436E+00	4.6686E+00	7.4185E+00	2.9340E+00	-7.2068E-04	PGAM
3	1.3977E+00	2.8876E+00	2.9583E+00	1.2787E+00	-1.6089E+00	4.1662E+00	6.4302E-01	-4.0158E-04	PGAM
4	0.	2.8796E+00	2.8796E+00	0.	-2.8796E+00	2.8796E+00	0.	1.7108E-03	PGAM
5	0.	0.	0.	0.	0.	0.	0.	0.	PGAM
6	0.	0.	0.	0.	0.	0.	0.	0.	PGAM
7	0.	0.	0.	0.	0.	0.	0.	0.	PGAM

IMAXUP = 2 IMAXDN = 0

MAXIMUM DIMENSIONS OF RADIATION LETHAL
VOLUME AND SURFACE EXCLUSION REGION

I	TEX, SEC	AX, KM	RDELEX, KM	REX, KM	RHEX, KM	NAMEH
1	5.1489E+00	3.2868E+00	6.7938E+00	3.2868E+00	0.	PGAM
2	4.2907E+00	2.5336E+00	5.3764E+00	3.2007E+00	1.5867E+00	PGAM
3	3.4326E+00	1.8761E+00	4.1609E+00	3.1288E+00	1.9726E+00	PGAM
4	2.5744E+00	1.3091E+00	2.9454E+00	3.0569E+00	2.3584E+00	PGAM
5	1.3977E+00	6.4302E-01	1.2787E+00	2.9583E+00	2.8876E+00	PGAM
6	8.5815E-01	3.7705E-01	7.8506E-01	2.9279E+00	2.8845E+00	PGAM
7	0.	0.	0.	2.8796E+00	2.8796E+00	PGAM

I	RUPEX, KM	NAMEU	RDNEX, KM	NAMED
1	6.7938E+00	PGAM	6.7938E+00	PGAM
2	3.7898E+00	PGAM	6.9631E+00	PGAM
3	2.1884E+00	PGAM	6.1335E+00	PGAM
4	5.8701E-01	PGAM	5.3039E+00	PGAM
5	-1.6089E+00	PGAM	4.1662E+00	PGAM
6	-2.0994E+00	PGAM	3.6695E+00	PGAM
7	-2.8796E+00	PGAM	2.8796E+00	PGAM

```
OVERALL MAXIMUM CONTOUR EXTENT

   RHMAX (KM)  =  2.8876E+00 FOR PGAM
   RDNMAX (KM) =  7.4185E+00 FOR PGAM
   RUPMIN (KM) = -2.8796E+00 FOR PGAM
```

Output Level 2 - Reduced Radiation Exclusion Region Data

```
        STATIC RADIATION FOOTPRINTS

              REENTRY PHASE

NEUTRON FOOTPRINT     CRITERIA =   1.00E+12 N/CM**2
TIME =   3.587E+00 SEC   HALF WIDTH =   1.836E+00   CENTER =   1.313E+00   HALF LENGTH =   3.149E+00 KM
GAMMA FOOTPRINT     CRITERIA =   1.00E+07 RAD(SI)/SEC
TIME =   5.149E+00 SEC   HALF WIDTH =   2.888E+00   CENTER =   2.269E+00   HALF LENGTH =   5.149E+00 KM
```

Output Level 3 - Combined Static Exclusion Region Data

STATIC CONTOUR PARAMETERS AND LIMITING ENVIRONMENTS

IDATA	TMN, SEC	TMX, SEC	RHMX, KM	RUPMN, KM	RDNMX, KM	NMT1	NMT2	NMRH	NMRU	NMRD
1	0.	5.1489E+00	2.8876E+00	-2.8796E+00	7.4185E+00	PGAM	PGAM	PGAM	PGAM	PGAM

Output Level 1 - AMM Exclusion Region Data Corresponding to Output on File 16. (See Common /RVC/ Definitions for Variable Definitions)

REENTRY DATA AS WRITTEN ON TAPE 16

ID INFORMATION

```
MODFA       =          RV B
MODFB       =          RV A
FHOB        =             S
FREANG(DEG) =   2.4000000E+01
```

STATIC REGION

```
FRSLEN(NMI) =   2.7802486E+00
FRSWID(NMI) =   1.5591548E+00
FRSCEN(NMI) =   1.2254027E+00
TINST (SEC) =   5.1488773E+00
```

DYNAMIC REGION

I	TIMDY(I) MIN	FRLENT(I) NMI	FRWIDT(I) NMI	FRCENT(I) NMI
1	0.	0.	0.	0.
2	1.5584961E-02	6.0270750E-01	7.0937232E-01	1.5927295E-01
3	2.5779248E-01	4.5591662E+00	2.3759941E+00	2.1831721E+00
4	5.0000000E-01	5.5296248E+00	3.2141891E+00	2.3154357E+00
5	5.9545898E-01	5.4300259E+00	3.3417347E+00	2.0882912E+00
6	6.9091797E-01	5.0633130E+00	3.3392575E+00	1.7240556E+00
7	2.5954590E+00	1.0150332E+01	2.1888837E+00	9.8488367E+00
8	4.5000000E+00	1.2795261E+01	3.1214611E+00	1.2418930E+01
9	9.7500000E+00	1.1750170E+01	5.1345605E+00	1.0413343E+01
10	1.5000000E+01	0.	0.	9.6068456E+00

Amm RV Fratricide Exclusion Problem Output

RV BRV AS

2.4000000E+01	2.7802486E+00	1.5591548E+00	1.2254027E+00	5.1488773E+00	0.
0.	0.	0.	1.5584961E-02	6.0270750E-01	7.0937232E-01
1.5927295E-01	2.5779248E-01	4.5591662E+00	2.3759941E+00	2.1831721E+00	5.0000000E-01
5.5296248E+00	3.2141891E+00	2.3154357E+00	5.9545898E-01	5.4300259E+00	3.3417347E+00
2.0882912E+00	6.9091797E-01	5.0633130E+00	3.3392575E+00	1.7240556E+00	2.5954590E+00
1.0150332E+01	2.1888837E+00	9.8488367E+00	4.5000000E+00	1.2795261E+01	3.1214611E+00
1.2418930E+01	9.7500000E+00	1.1750170E+01	5.1345605E+00	1.0413343E+01	1.5000000E+01
0.	0.	9.6068456E+00			

3.0 COMPUTER CODE MAINTENANCE AND UPDATE

The NWEM computer code was developed with a philosophy to make maintenance and update easy. With this philosophy in mind, the code was structured in a modular form for ease of changing not only individual subroutines or functions but complete environmental model and exclusion region contour generating routines, of extending the allowed exclusion region shapes and time increments and of expanding the prestored data base. By having the flexibility, the NWEM computer code can virtually be modified to perform a variety of studies depending on the complexity of the environmental models and the detail of the exclusion region data used. The objective of this section is not to define studies to be performed by NWEM but to give the user information necessary to make modifications to the NWEM computer code if needed. To this end, this section discusses data base extension, environmental model modification and extensions of the exclusion regions.

3.1 DATA BASE EXTENSION

As previously stated in the block data description section, it was decided to prestore input quantities in block data that are needed for the radiation transmission data and booster trajectory data to facilitate code check-out. To a limit, this technique of prestored data can be extended to include increasingly more sets of transmission data and trajectories.

If a user desires to make these changes, he will be required to expand the appropriate dimension statement limits designating the number of sets of data stored and, if necessary, the dimension statement limits designating the number of values stored per data set. In addition, there are variables specifying storage limitations which may require change. As the code is presently set up, it is relatively easy to add sets of data with the number of values per set equal to or less than the present storage limitations. This type of addition of data is recommended. To change the numbers of data values stored per set requires updating all common blocks associated with that data throughout the code, but will not require any other reprogramming since those parts of the code using this data are programmed to handle a variable number of data values.

To make use of this technique for booster trajectories for adding data sets of less than or equal values, it is necessary to increase the index of the /TRAJX/ common variables in block data and subroutine INPREP from its present value of 1 to the appropriate number and enter, in the appropriate order, in block data the trajectory data as a function of time after launch, the number of data values per set and the number of sets. If there is a change required of the first index, then the additional change of the value of the variable NTRJM (common /TRNSL/) and common blocks /TRAJ/ and /HTRAJ/ must be changed appropriately in each subroutine in which they appear.

For the radiation transmission data extension, a similar procedure is used. Depending on the environment updated, the index of those variables in common /SØR/ corresponding to that environment are increased and values entered. For increases in the number of values per set, it is necessary to change the value of the variables INETM and IXRM appropriately, and the indexes of common block /ØUT/ must be changed appropriately for each subroutine in which it appears.

As mentioned earlier this technique of data extension will reach a limit. This limit is the restriction computer code size places on the user. Since these dimensioned variables require storage, eventually the core size will be exceeded and another method of access of the data will be necessary. A logical choice is one or more data files. As the NWEM computer code is currently written, minor modifications are required to implement this method. The only changes would be to replace the current block data logic with file reading logic in the INPREP subroutine.

For any data extensions undertaken, however, the user is cautioned to review in detail the definitions of the common block concerned and be very familiar with the INPREP subroutine.

3.2 ENVIRONMENT MODEL REPLACEMENT

Because the NWEM computer code has been structured as a compilation of independent environment models and exclusion region contour generating routines, replacements or exchange of environment models is simplified. Additionally, one of the objectives of presenting the subroutine descriptions and common block descriptions in the formats used is to enable

the user to completely understand the input and output variables of each routine and to trace the flow of the calculation down through the other routines. With this information, the user can determine routines and variables affected and correctly make the necessary changes to supply the rest of NWEM with the appropriate data from his replacement routines.

Obviously, it would be misrepresentation to imply that environment model replacement can be undertaken by anyone or without considerable experience with the code. However, once this experience has been gained, the user should be able to effect the changes.

As an example, assume that the RV trajectory is to be replaced. (While this example is not an environment model, it will serve as a straight forward example). The input to the present routines is the RV geometry parameters (see subroutine PTMASS) and possibly the drag force coefficients, common /DRAG/, and the output is the RV trajectory, common /TRAJ/, and possibly again the drag force coefficients, common /DRAG/. To effect the change, the new routines only need to be able to use this input data and output the required data to NWEM. Those subroutines and functions (in NWEM) compatible with those in the replacement routines can be used or for minimum interactions no other connections between NWEM and the replacement routines are needed.

3.3 EXTENSION OF ALLOWED EXCLUSION REGION CONTOURS

This area of code update is the most complex of the three considered. Because there exist restrictions imposed by the limitations and restrictions placed on the exclusion region contours by AMM, routines had to be developed which would combine the individual environmental exclusion routines and construct the AMM exclusion region contours (see Volume 1). To extend the AMM exclusion region contours, the user must be very familiar with the function of these special routines. However, the individual environment models and exclusion region contour generating routines provide detailed exclusion region contour information which can be used as they are presently as a bases for the AMM extended exclusion region contours. The combining routines modified to provide the desired data. Since any realistic example of extensions of this type are quite involved

and require knowledge of the code, none will be provided in the hope that before the user attempts it he will be familiar with the code and will be able easily to effect a change of this type.

One type of extension, however, that only requires an understanding of the code is to use the detailed exclusion region data and manipulate this data directly. Essentially all special routines are eliminated and replaced with those of the user's design. While this method is easier from a code understanding position, it may require considerable code development effort depending on the required type of output data.

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